COOPERATIVE RABIES MANAGEMENT PROGRAM
NATIONAL REPORT 2007

WS Wildlife Services

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United States Department of Agriculture
Animal and Plant Health Inspection Service

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NATIONAL REPORT 2007

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EXECUTIVE SUMMARY

Operational oral rabies vaccination (ORV) programs in the United States. began in the early 1990s in New Jersey and Massachusetts with the goal of preventing the raccoon (*Procyon lotor*) variant of rabies from spreading to populated vacation areas of Cape May and Cape Cod, respectively. The U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program's initial involvement in cooperative ORV was in 1995 in south Texas to prevent canine rabies in coyotes (*Canis latrans*) from gaining a larger foot-hold in the U.S. One year later, an ORV program began in west-central Texas to prevent rabies in gray foxes (*Urocyon cinereoargenteus*). The following year, WS cooperated to implement ORV projects in Ohio and Vermont to prevent the spread of raccoon rabies. Wildlife Services' National Rabies Management Program (NRMP) continued to grow over the next 8 years and in 2007 included ORV programs targeting raccoon rabies in 16 eastern states and canine and gray fox rabies in Texas. In addition, WS continued a pilot ORV project targeting feral dogs (*Canis lupus familiaris*) on the Navajo Nation in Arizona. Overall in 2007, WS participated in coordinated ORV programs to distribute more than 12.2 million baits over 225,645 km^2, an area the size of Minnesota (Table 1).

Table 1. Operational oral rabies vaccination (ORV) bait distribution and area baited by Wildlife Services and their cooperators in the United States, 2007.

State	Target species	ORV baits distributed	Area baited (km^2)	Bait distribution methods
Alabama	Raccoon	1,085,437	10,622	Fixed-wing, ground
Arizona	Feral dog	366	55	Ground
Florida[a]	Raccoon	540,825	7,655	Fixed-wing, ground, helicopter, boat
Georgia	Raccoon	89,560	1,451	Fixed-wing, ground
Maine	Raccoon	50,000	702	Fixed-wing, ground
Maryland	Raccoon	103,038	1389	Fixed-wing, ground, helicopter
Massachusetts	Raccoon	131,596	494	Ground, helicopter, bait station
New Hampshire	Raccoon	31,905	553	Fixed-wing, ground
New Jersey	Raccoon	45,600	556	Ground, helicopter
New York	Raccoon	1,563,046	27,788	Fixed-wing, ground, helicopter, bait station
North Carolina	Raccoon	184,029	2,917	Fixed-wing, ground
Ohio	Raccoon	1,123,259	10,006	Fixed-wing, ground, helicopter
Pennsylvania	Raccoon	1,220,340	16,613	Fixed-wing, ground
Tennessee	Raccoon	840,222	11,570	Fixed-wing, ground
Texas	Coyote	729,888	30,783	Fixed-wing, ground, helicopter
Texas	Gray fox	2,342,410	63,241	Fixed-wing, ground, helicopter
Vermont	Raccoon	421,179	9,168	Fixed-wing, ground
Virginia	Raccoon	320,365	5,053	Fixed-wing, ground
West Virginia	Raccoon	1,388,231	25,029	Fixed-wing, ground
Total		12,211,296	225,645	

[a] Includes baits distributed by county officials in Broward County.

In the Northeast, WS continued cooperation with Cornell University, state agencies and international partners in New Brunswick, Quebec, and Ontario, Canada to try to prevent the northern and western spread of raccoon rabies. These ORV zones extended along a portion of the New Brunswick border with Maine, the Quebec border with New Hampshire and Vermont, and the Ontario border in northern and western New York (Figure 1). As a continued response to the first ever case of raccoon rabies being confirmed in Quebec in 2006, WS in Vermont and New York implemented trap-vaccinate-release (TVR) efforts in 2007. As a result of these border efforts, 2,135 animals were hand vaccinated and released in Vermont (1,226) and northeastern New York (909).

As a component of the greater Appalachian Ridge (AR) ORV zone, Ohio continued biannual baiting of the Contingency Action (CA) ORV zone (east of Cleveland) in the spring and fall of 2007. Wildlife Services integrated TVR into the rabies control campaign within the CA zone to prevent the spread of raccoon rabies that was first detected there in 2004. As a result of this effort, 1,285 animals were hand vaccinated and released in northeastern Ohio. The number of rabid animals with raccoon variant in this CA zone decreased to 19 cases in 2007 with enhanced surveillance in place (from a high of 46 cases in 2004).

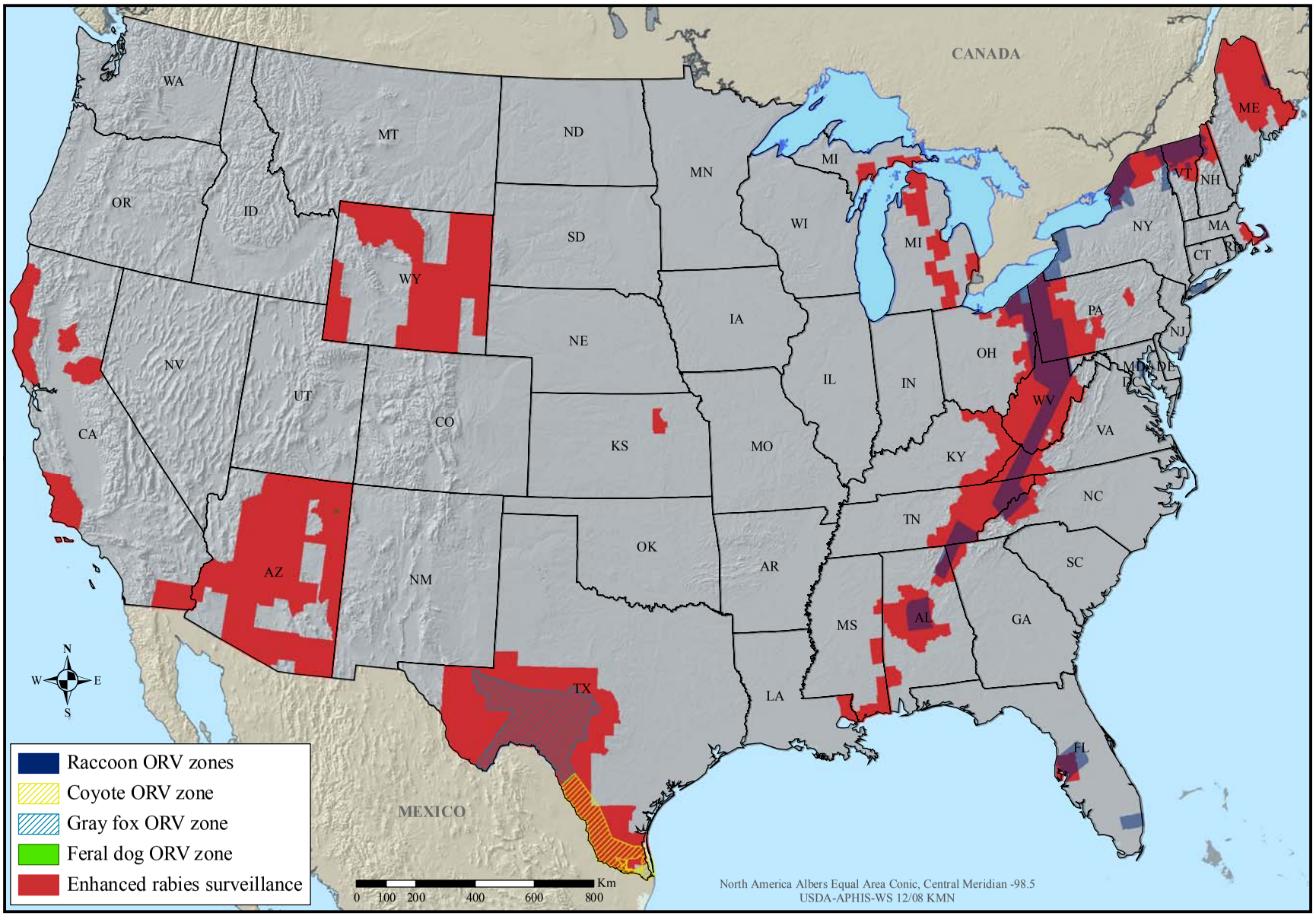

Figure 1. Terrestrial wildlife rabies variants with species-specific cooperative oral rabies vaccination (ORV) zones and Wildlife Services enhanced rabies surveillance counties in the United States, 2007.

The AR ORV zone extended from Lake Erie in Ohio and Pennsylvania, south through West Virginia and western Virginia, to northeastern Tennessee and North Carolina in 2007 (Figure 1), where it interfaced with the high mountainous habitats that do not support robust raccoon populations based of WS density indices. The AR ORV zone, along with the Georgia-Alabama-Tennessee (GAT) ORV zone, baiting operations near Birmingham, Alabama, and natural barriers made up control programs targeting raccoons that reached from Lake Erie to the Gulf of Mexico.

In 2007, WS continued to participate in cooperative ORV projects in Massachusetts, New Jersey, eastern Maryland, Florida, and on Long Island, New York (Figure 1). These projects provided information on ORV and surveillance strategies. Future contingency actions are planned to integrate TVR with ORV to restore Cape Cod to raccoon rabies free status. The current strategy is to systematically conduct control from the eastern part of the Cape back toward the Canal, with the objective of ultimately recreating an ORV zone west of the canal that is sufficient to prevent raccoon rabies reemergence on Cape Cod. Cape May, New Jersey is the longest running operational ORV project in the U.S. and WS' role continues to be limited post-ORV evaluation. The Maryland project is designed to investigate if ORV can be used to eliminate raccoon rabies from peninsulas on Chesapeake Bay. The Florida ORV program is an extension of the long-standing Pinellas County project, with a near-term goal of determining if rabies-free areas can be created and maintained, with the initial attention to Pinellas County. Raccoon rabies was detected on Long Island in August 2004. Enhanced surveillance, TVR and ORV were implemented around the initial focus. Planning for future actions and roles and responsibilities will be determined through input from county, state, federal and university cooperators.

Wildlife Services assumes an important cooperative role with the Texas Department of State Health Services (TDSHS) and several other agencies and organizations in ORV efforts that began in Texas in 1995. The canine rabies control program in coyotes is a combination of surveillance, with reliance on maintaining a 64-kilometer (40-mile) wide ORV zone along the Rio Grande River (Figure 1), to prevent this rabies variant from re-emerging in Texas from feral dogs in Mexico. Single cases were confirmed near Laredo in 2001 and 2004 within 1.6 km (1 mi) of the U.S.-Mexico border. No additional cases have been reported since 2004 and the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) declared the United States free of canine rabies in 2007.

Wildlife Services is also an important funding and operational partner with the TDSHS in conducting ORV efforts to contain a unique gray fox rabies variant in west-central Texas (Figure 1). In February 2007, 2 cases of rabies involving this Fox variant were confirmed by the TDSHS west of the recently completed west-central Texas ORV zone. The TDSHS and WS responded to these rabies cases by establishing an enhanced rabies surveillance area. Within this area, both agencies increased public awareness of the rabies outbreak and the need for testing unusual acting animals. Two contingency actions were initiated (February and March) not only to contain an outbreak of this fox variant in far west-central Texas but also to address the spillover into coyotes. By year's end, 16 of the 33 confirmed cases (48.4%) within the contingency areas involved coyotes. In addition, analysis of salivary glands from 5 Texas fox variant positive coyotes by the CDC revealed 3 of the 5 coyotes tested had a rabies viral load comparable to those found in south Texas during the canine variant outbreak in coyotes, suggesting the possibility of coyote-to-coyote transmission of this fox variant in west-central Texas. In 2007, WS contributed over 2.3 million baits and assisted with bait distribution over more than 63,000 km^2 (25,000 mi^2) to contain gray fox rabies in Texas. Wildlife Services also provides field expertise, infrastructure, and equipment to help obtain samples for continued monitoring and evaluating of ORV status targeting coyotes and gray foxes in Texas.

A pilot ORV study was conducted in Flagstaff, Arizona in 2005 and 2006 in response to the re-emergence of rabies in the striped skunk (*Mephitis mephitis*) population that originated in big brown bats (*Eptesicus fuscus*). These studies represented the first operational attempts to field test the performance of Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) specifically targeting skunks. Over the 2-year study, only 8 of 54 skunks (14.8%) demonstrated a detectable rabies antibody response (titer ≥0.05 IU) and 7 of the 8 had a record of recent hand vaccination with Rabdomun® (Schering-Plough Animal Health Corporation, Summit, New Jersey, USA). In the eastern U.S., where raccoon variant rabies frequently spills over into striped skunks, there has been virtually no detectable antibody response in skunks related to large scale, multi-year ORV projects targeting raccoons. Due to these findings, the pilot ORV study in Flagstaff was not continued in 2007, but WS did continue its TVR campaign in an effort to restore Flagstaff to terrestrial rabies-free status. Over the 5-year TVR effort (2001 and 2004-2007), 655 animals were trapped, vaccinated, and released: 614 striped skunks, 37 raccoons, 2 gray foxes, 1 feral cat (*Felis catus*), and 1 Western hog-nosed skunk (*Conepatus mesoleucus*). The significance of skunks infected with non-skunk variant rabies remains unclear, but the apparent inability to orally vaccinate them with the currently licensed oral rabies vaccine and bait could potentially confound progress toward effective raccoon rabies control in the

eastern U.S. The Arizona program remains critical to better understanding the role skunks play in rabies outbreaks and the nationwide efforts to reduce and eventually eliminate terrestrial rabies from the U.S.

A pilot study that began in 2005, continued in 2007 in the vicinity of Chinle, Arizona on the Navajo Nation to field test Raboral V-RG® and determine rabies titer levels in feral dogs that may have been exposed to the vaccine. These were the first field trials of their kind specifically targeting feral dogs in the U.S. Over the 3 years, 55 of 207 dogs (26.6%) showed a positive rabies antibody response. Coated sachet (CS) baits were used during ORV field trials in Arizona in 2007. The efforts represent potential for technology transfer to Mexico and other countries where dog rabies remains a problem.

In 2007, WS and cooperators continued to shift from fishmeal polymer (FMP) baits to CS's, with nearly 6.2 million CS baits distributed. At $1.00/bait CS's are $0.25 less expensive than FMP baits, less likely to cause damage from aerial distribution, more palatable to smaller carnivores like skunks, and perform generally at least as well as FMP baits based on field titer responses from Cornell University. The shift to CS's is currently viewed as only an interim management step until improved or new baits can be developed, licensed and produced.

Wildlife Services and cooperators implemented contingency actions in New York, Ohio, Texas, and Vermont in 2007. Contingency actions often include an integration of ORV, TVR, and increased enhanced rabies surveillance. Enhanced surveillance is designed to complement public health surveillance and provide greater intensity and scope in suspect animal testing to delineate the leading edge of rabies distribution, allowing for sound ORV decisions while maximizing the effective use of resources. Enhanced surveillance includes obtaining samples from: animals exhibiting behaviors suggestive of rabies, but not implicated in human or domestic animal exposures; road kills; other animals found dead; animals with wounds or lesions suggestive of rabies; and animals removed near locations where rabies has recently been confirmed. In 2007, WS continued to enhance rabies surveillance in most of the states conducting ORV for raccoons, as well as emphasizing surveillance in adjacent states west of the raccoon ORV zone including Michigan, Kentucky, Mississippi and Louisiana (Figure 1). Texas collected 1,345 animals in support of coyote and gray fox ORV programs. Arizona collected and tested 278 animals (all negative) in support of feral dog ORV and continued skunk research. In addition, California, Kansas, and Wyoming collected and submitted animals for testing to enhance surveillance of skunk variants of rabies. Overall during enhanced surveillance efforts in 2007, WS' cooperation led to the collection and submission of 10,812 samples for rabies testing that otherwise may not have been tested through the public health surveillance system (Table 2); 379 of these tested positive for rabies.

Since 2005, 35 WS personnel have attended direct rapid immunohistochemistry test (dRIT) training at the CDC in Atlanta, Georgia. The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance in the U.S. Animals involved in potential or actual rabies exposures with humans or domestic animals continue to be processed by public health experts at established local, state, or federal laboratories. From 2005-2007, WS implemented the dRIT in 16 states. In 2007, WS (and the TDSHS) tested 9,037 (83.6%) animals from enhanced surveillance using the dRIT; 187 tested positive for rabies (Table 2).

In all states conducting ORV, WS continues to take the lead on post-ORV monitoring to evaluate program effectiveness by collecting blood and tooth samples for determining rabies virus neutralizing antibody (VNA) levels and bait uptake (when appropriate) in raccoons, skunks, coyotes, and foxes. Density indexing is also used to characterize raccoon and skunk populations and to provide post-ORV serum samples for analysis. Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, most states had received 2007 serology results so they have been included here instead (2006 serology results were included in the 2006 annual report).

All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Table 2. Wildlife Services enhanced rabies surveillance and use of the direct rapid immunohistochemistry test as part of rabies management programs in the United States, 2007.

State	Enhanced surveillance animals	WS tested by dRIT	Rabid by dRIT
Alabama	137	73 (53.3%)	0
Arizona	278	278 (100%)	1
California[a]	n/a[b]		
Florida	125	0	
Georgia	81	81 (100%)	3
Kansas[a]	n/a[c]		
Kentucky[a]	132	132 (100%)	0
Louisiana[a]	2	2 (100%)	0
Maine	130	96 (73.8%)	2
Maryland	0		
Massachusetts	151	0	
Michigan[a]	35	35 (100%)	0
Mississippi[a]	76	76 (100%)	0
New Hampshire	3	0	
New Jersey	0		
New York	76	0	
North Carolina	128	127 (99.2%)	50
Ohio	921	921 (100%)	20
Pennsylvania	3,269	3,135 (95.9%)	61
Tennessee	1,509	1,499 (99.3%)	19
Texas	1,345[d]	1,074 (79.9%)[d,e]	21
Vermont	705	0	
Virginia	162	162 (100%)	2
West Virginia	1,346	1,346 (100%)	8
Wyoming[a]	201	0	
Total	10,812	9,037 (83.6%)	187

[a] ORV not applied in this state.
[b] Wildlife Services removed 5,030 skunks in California during routine wildlife damage management activities; the number submitted for rabies testing was not recorded.
[c] Wildlife Services removed skunks from Fort Riley Military Installation during routine wildlife damage management activities; the number submitted for rabies testing was not recorded.
[d] Includes 29 animals from New Mexico; all tested negative using the dRIT.
[e] Includes samples tested by the Texas Department of State Health Services using the dRIT.

In 2007, a mean positive antibody response of 33±16% was observed for 3,908 raccoon serum samples collected post-ORV (Georgia, Massachusetts, and Pennsylvania results were not available at the time of printing) (Table 3). Sera were also collected from 194 skunks, 4 fishers (*Martes pennanti*), 4 gray foxes, 4 red foxes (*Vulpes vulpes*), and 1 opossum (*Didelphis virginiana*) during raccoon rabies management programs. Three skunks (2%), 3 gray foxes (75%), and 1 red fox (25%) had a detectable rabies VNA response. Texas collected serum samples from 120 coyotes and 138 gray foxes to evaluate ORV efficacy targeting those species in south and west-central Texas, respectively; 59 (49%) coyotes and 102 (74%) gray foxes demonstrated positive rabies VNA responses (Table 3). Texas also collected sera from 18 coyotes, 10 skunks, 4 bobcats (*Lynx rufus*), 2 raccoons, and 1 ringtail (*Bassariscus astusus*) during evaluation of the gray fox ORV program. Nine coyotes (50%) and 3 skunks (33%) had detectable rabies antibodies. Arizona collected serum samples from 63 dogs within the ORV pilot study area of Chinle (Table 3). Seventeen dogs (27%) had positive rabies VNA responses.

The need for a bait-vaccine combination producing higher levels of rabies VNA in meso-carnivore species serving as rabies reservoirs remains the highest research priority and requires continued systematic research. In 2007, research at Thomas Jefferson University in Philadelphia, Pennsylvania and at the CDC focused on the development of new, safe, and effective oral rabies vaccines with canine adenovirus as a prospective vector for expression of the rabies glycoprotein gene.

Table 3. Wildlife Services post-oral rabies vaccination (ORV) sampling efforts as part of rabies management programs in the United States, 2007; at the time of printing, most states had serology results for the current year (2007) so they have been included here.

State	All post-ORV serum samples	Positive rabies antibody response (≥0.05 IU)	4-12[a] weeks post-ORV samples	Positive rabies antibody response (≥0.05 IU)
Raccoon[b]				
Alabama	125	87 (69.6%)	125	87 (69.6%)
Florida	190	56 (29.5%)	190	56 (29.5%)
Georgia	not available at printing			
Maine	124	37 (29.8%)	124	37 (29.8%)
Maryland	258	119 (46.1%)	258	119 (46.1%)
Massachusetts	not available at printing			
New Hampshire	10	1 (10.0%)	10	1 (10.0%)
New Jersey	0		0	
New York	422	52 (12.3%)	282	51 (18.1%)
North Carolina	120	30 (25.0%)	120	30 (25.0%)
Ohio	740	185 (25.0%)	53	9 (17.0%)
Pennsylvania	not available at printing			
Tennessee	355	125 (35.2%)	300	112 (37.3%)
Vermont	995	281 (28.2%)	219	53 (24.2%)
Virginia	324	111 (34.3%)	210	82 (39.0%)
West Virginia	245	115 (46.9%)	133	65 (48.9%)
Total	3,908	1,199 (30.7%)	2,024	702 (34.7%)
Mean ± St. Dev.		33±16%		33±17%
Arizona (feral dog)	63	17 (27.0%)	n/a[c]	
Texas (coyote)	120	59 (49.2%)	120	59 (49.2%)
Texas (gray fox)	138	102 (73.9%)	138	102 (73.9%)

[a] Samples taken during optimal evaluation period of 4-12 weeks post-ORV bait distribution.
[b] Non-raccoon samples collected during raccoon rabies management programs are not represented in this table.
[c] Samples were collected 6-24 weeks post-ORV but unable to differentiate samples collected 4-12 weeks post-ORV.

Several pen, laboratory, and field studies were continued or initiated through WS' National Wildlife Research Center (NWRC) in Fort Collins, Colorado. Pen and laboratory studies were conducted at the NWRC and Colorado State University, while field studies were conducted in Alabama, Ohio, Pennsylvania, and Texas. Studies involved research on: bait development to better deliver V-RG® to raccoons and skunks; ecology of raccoons and gray foxes in rural and urban areas; better use of biomarkers to evaluate vaccine uptake by target and non-target wildlife; the evaluation of geographic barriers for wildlife dispersal that may affect the spread of rabies; and determining long-term efficacy of V-RG® vaccine in raccoons.

In 2008, WS and cooperators will continue to focus on implementing adequate enhanced rabies surveillance in conjunction with ORV to determine areas at risk of rabies spread and to monitor program success. Adjustment to ORV zones may occur as a result of improved surveillance information. Contingency actions are expected to continue in New York, Ohio, Vermont, and Texas in 2008. Commitments will continue toward improvements to the existing bait-vaccine and development of new bait-vaccines that perform better and are efficacious in all carnivore reservoirs. Wildlife Services will continue to participate in formal meetings with counterparts from Canada, Mexico, and the Navajo Nation on the completion of a North American Rabies Management Plan (NARMP) that identifies information exchange, enhanced surveillance, rabies control, and research as key needs toward meeting continental goals for rabies management. The NARMP is expected to be finalized at a signing ceremony planned during the XIX International Conference on Rabies in the Americas to be held at the CDC in Atlanta, Georgia in September 2008.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
ALABAMA 2007

BACKGROUND

Raccoon (*Procyon lotor*) rabies is thought to have entered Alabama in the late 1970s from Florida. The raccoon variant of the rabies virus has since been detected in most counties east and south of the Alabama-Coosa River system and is now considered enzootic there. Since 1998, several confirmed raccoon rabies breaches of the Alabama and Coosa Rivers (Figure 1) have occurred in the following counties: Madison, Mobile, Dallas, Clarke, Bibb, Autauga, Elmore, Cherokee, Shelby, and Jefferson. These cases, however, appeared to be fairly isolated and limited to usually 1 animal per occurrence.

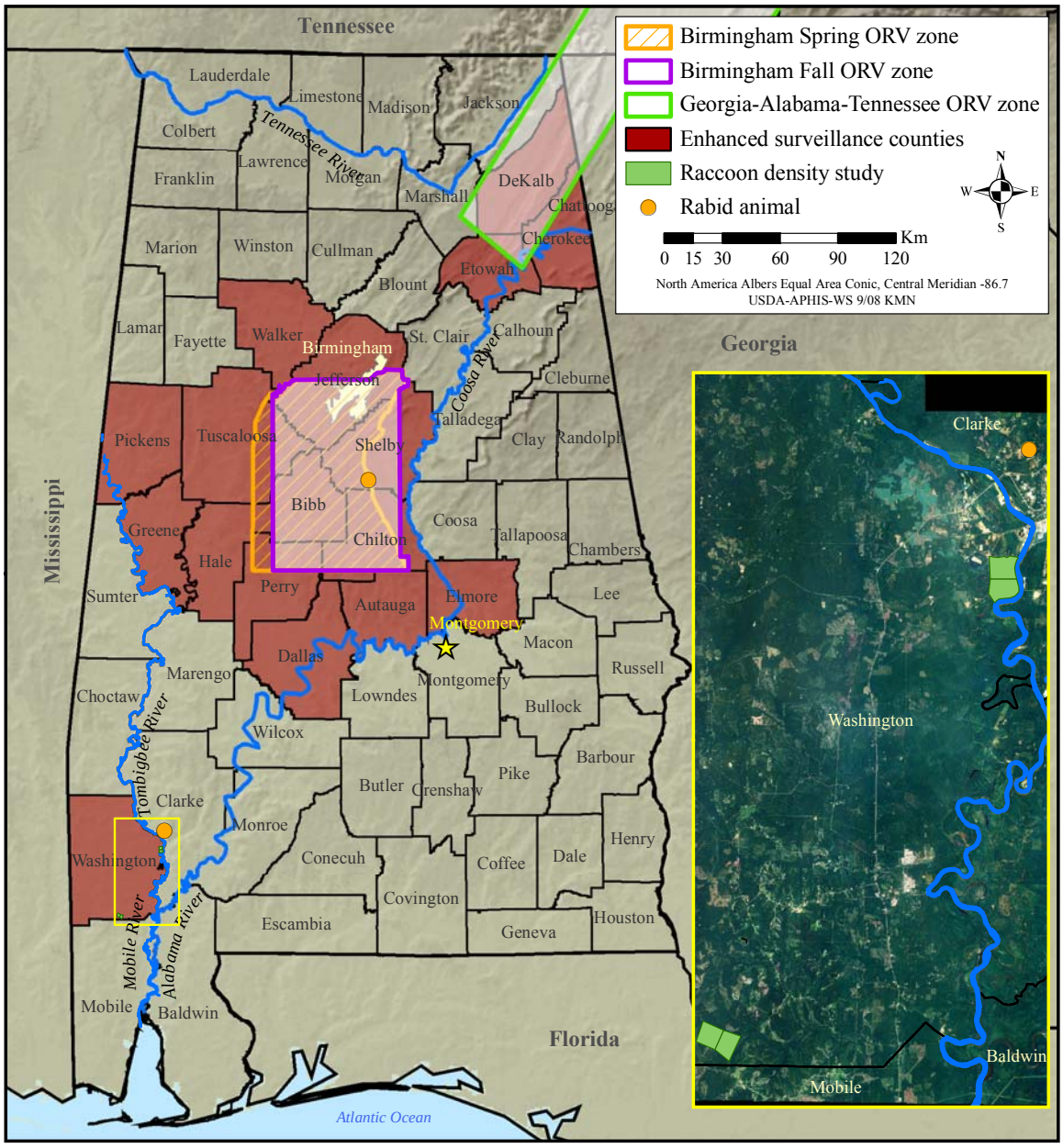

Figure 1. Wildlife Services cooperative rabies management program activities in Alabama, 2007.

In 2001, the Alabama Department of Public Health (ADPH) asked Wildlife Services (WS) and other cooperators to help determine the leading edge of the raccoon variant in the state in hopes of developing an effective oral rabies vaccination (ORV) program to keep raccoon rabies from spreading into western Alabama. In late 2001, WS began conducting enhanced surveillance of road killed and trapped raccoons in counties west of, and bordering, the Alabama and Coosa Rivers.

Between 2002 and 2007, surveillance conducted by WS and the ADPH confirmed 18 raccoon rabies cases in both domestic and wild animals in Autauga, Elmore and Clarke Counties (where it had previously been detected) and Cherokee, DeKalb, Shelby, and Jefferson Counties (where it had never been detected), indicating that raccoon rabies might be on the move westward. As a result of earlier positives, in the fall of 2003, the ADPH and the Alabama Department of Agriculture and Industries (ADAI) cooperated with Alabama WS and WS offices in Georgia and Tennessee to initiate Alabama's first ever ORV effort in 5 northeast counties. Since then, Alabama WS has participated in 9 additional ORV distributions in both northeast Alabama (as part of the Georgia-Alabama-Tennessee [GAT] zone) and central Alabama (Birmingham and Selma zones), all in response to newly confirmed positive cases that indicated raccoon rabies was potentially moving westward.

Two new raccoon rabies cases were identified west of the Alabama-Coosa Rivers in 2007. The first case was on 26 April in Shelby County near Calera (Figure 1). A puppy was taken to a veterinarian after getting into a fight with a raccoon. It was boarded at the vet's office and over the next two weeks it began showing clinical signs of rabies. It tested positive for raccoon variant rabies and the veterinary staff that handled the animal received post-exposure boosters. This case was on the eastern edge of the 2007 Birmingham Spring ORV zone. The zone was subsequently moved to the east in the fall to incorporate the location of this case.

The second case was in Clarke County near the town of Jackson (Figure 1). On 26 October, a Jackson animal control officer responded to an aggressive red fox (*Vulpes vulpes*) call. The animal was confirmed positive for rabies by the Mobile Health Department Laboratory, but the variant had not been typed by the end of 2007. No new raccoon rabies cases were identified in the any other previous ORV bait zones in 2007. Surveillance in these areas will continue with cooperation from the ADPH and the Alabama Department of Conservation and Natural Resources.

ORV PROGRAM 2007

Bait Distribution

For the fifth consecutive year, WS participated in bait distribution efforts throughout central and northeastern Alabama; 1,085,437 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 10,622 km^2 (4,103 mi^2) in 2007 (Figure 1). Since its program inception in 2003, WS has distributed 3,733,727 ORV baits in Alabama. Aircraft and pilots for all Alabama ORV programs in 2007 were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS provided ground support and served as navigators and flight crew in the planes.

Birmingham Spring.--The Birmingham ORV zone was baited in the spring of 2007 for the fourth time overall in response to previous raccoon rabies cases detected in Shelby County in 2004, 2005, and 2007 and in Birmingham in October 2005. Raccoon rabies had not been detected in Jefferson or Shelby Counties prior to these occurrences. From 19-21 March, 434,503 baits (324,351 fishmeal-coated sachets [CS] via fixed-wing aircraft and 110,152 fishmeal polymer [FMP] baits by hand baiting) were distributed over 6,537.6 km^2 (2,525.1 mi^2) that included Bibb, Chilton, Dallas, Hale, Jefferson, Perry, Shelby, and Tuscaloosa Counties (Figure 1). Ground support for aerial baiting and ground bait distribution was provided by WS, Jefferson County Department of Health environmentalists, and volunteers from the Centers for Disease Control and Prevention (CDC). Aerial baiting activities were based out of the airport in Bessemer, Alabama.

Birmingham Fall.--The Birmingham ORV zone was repeated in the fall of 2007, but was shifted to the east in response to a rabid dog confirmed in Shelby County after the spring baiting. From 3-9 October, 445,297 baits (317,037 CS's via fixed-wing aircraft and 128,260 FMP baits by hand baiting) were distributed over 6,561.7 km^2 (2,534.5 mi^2) that included Bibb, Chilton, Dallas, Jefferson, Perry, Shelby, and Tuscaloosa Counties (Figure 1). Ground support for aerial baiting and ground bait distribution was provided by WS and volunteers from the CDC. Aerial baiting activities were based out of the airport in Albertville, Alabama and coincided with aerial baiting of the GAT ORV zone.

Georgia-Alabama-Tennessee.--The objective of Alabama's 2007 GAT ORV zone was to continue to prevent the westward movement of raccoon rabies from northwest Georgia into Cherokee and DeKalb Counties. No new raccoon rabies cases had been detected in northeast Alabama since the first GAT program was initiated in 2003. From 3-9 October, 205,637 FMP baits (176,837 by air and 28,800 by hand) were distributed over 3,200.6 km^2 (1,236.2 mi^2) of Cherokee, DeKalb, Etowah, Jackson, and Marshall Counties (Figure 1). Ground support for aerial baiting and ground bait distribution was provided by WS and volunteers from the CDC. Aerial baiting activities were based out of the airport in Albertville, Alabama.

Enhanced Surveillance

In 2007, WS continued enhanced surveillance by collecting raccoons, bobcats (*Lynx rufus*), gray foxes (*Urocyon cinereoargenteus)*, and coyotes (*Canis latrans*) that were abnormally behaving, road killed, a nuisance, or found dead in unusual places in counties west of the Alabama and Coosa Rivers. The goal of this surveillance was to determine the leading edge of the raccoon variant in Alabama. Wildlife Services cooperated with animal control personnel, county health department environmentalists, and wildlife law enforcement officers to collect 137 animals for rabies testing (Table 1). All of these animals tested negative for rabies.

Table 1. Animals collected for rabies testing by Wildlife Services in Alabama, 2007 (no rabies positives).

County	Raccoon	Bobcat	Gray fox	Coyote	Total
Autauga	1		1		2
Bibb	6		1		7
Cherokee	2				2
Chilton	6				6
Dallas	1				1
DeKalb	4				4
Elmore	1				1
Etowah	1				1
Greene[a]	1				1
Hale	16				16
Jefferson	24				24
Perry	1				1
Pickens[a]	1				1
Shelby	22				22
Tuscaloosa	34	5	2	1	42
Walker[a]	3	1		1	5
Washington[a]		1			1
Total	124	7	4	2	137

[a] ORV never applied in this county.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

During 2007, WS collected 137 animals for rabies testing (Table 1) and 73 were tested by WS using the dRIT (53.3%). Two of the 137 samples were forwarded directly to the ADPH Laboratory because of reports of human or animal exposure. Ten percent of all negatives were sent to the CDC for confirmation. The CDC (using the dFA test) had 100% agreement with the WS dRIT test results for negative samples. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Alabama.

Population Monitoring

In 2007, Alabama was selected (alongside Pennsylvania and Vermont) to perform paired 15-day density studies, replicated 30 days apart, to continue to test the National Rabies Management Program's (NRMP's) "high density protocol" for indexing raccoons (50 cage traps set on a target study area of 3 km² for 15 consecutive nights). In Pennsylvania and Vermont, studies were conducted prior to annual ORV and then 30 days later (post-ORV distribution). The study sites in Alabama, however, were chosen in ORV naïve areas of Washington County to increase surveillance and better understand why there has been a consistent number of rabies cases over the past 5 years, all west of the Alabama River. This area is difficult to establish an enhanced surveillance network because of low human population, local attitudes, and rural nature. The majority of roads are in rural areas with little to no shoulder. A single 4-lane road runs north to south in the vicinity where the rabies cases occurred, making road kill surveys challenging.

The primary habitat of this region is short rotation pine monocultures with streamside management zones (SMZ's) which may be used as the main travel corridors for raccoons. Pine stands vary in age, but continuous logging of 50-1,000 acre tracts may impede the movement of raccoons westward. The SMZ's only constitute a small portion of the region but may support the majority of the raccoon population.

Two major river systems flow north to south through the region: the Tombigbee and Alabama Rivers converge at the southern end of Clarke County creating the Mobile-Tensaw River system. These rivers are the eastern, western and southern boundaries of Clarke County (Figure 1). River system habitat is dominated by lowland hardwoods with occasional swamps nearby. Primary streams that empty into the rivers may create travel corridors with localized increased raccoon densities. Although of small acreage compared to the majority of the region, these SMZ's may harbor the greatest raccoon densities and may provide a corridor for raccoon variant rabies to move westward.

A "flanking" phenomenon may also be occurring in the region. The Tombigbee River runs due north while the Alabama River runs north then turns east about midway through the state. Clarke County harbors the most westerly confirmed positives, therefore, an infected raccoon may travel north along the Tombigbee's east edge causing positives to appear far west of the ORV zones in central Alabama. Increased surveillance should be initiated following the eastern side of the Tombigbee River in order to substantiate this statement.

Six density studies were ultimately conducted in Alabama during 2007, all in Washington County (Figure 1 inset and Table 2). The Boykin paired studies were not repeated 30 days later (as planned) because of extremely low capture totals during the first sampling period (1 raccoon in 500 trap nights triggered the NRMP's "low density protocol" which called for the study to be stopped after 5 days). The other paired studies (Washington A1 and B1) were conducted as planned and repeated 30 days later (Washington A2 and B2).

During the 6 studies, blood and tooth samples were collected from most of the unique raccoons. Samples were not collected from raccoons captured in sampling period 2 that had been previously captured in sampling period 1 because there was no ORV distribution in place to change their serologic values.

All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Table 2. Index to raccoon densities in Washington County, Alabama, 2007; all studies conducted in areas without oral rabies vaccination (ORV) treatment (ORV naïve).

	Boykin A1	Boykin B1	Wash. A1	Wash. B1	Wash. A2	Wash. B2
Time of study	23-28 July		17 Aug.-1 Sep.		30 Sep.-15 Oct.	
Macrohabitat	Forested (commercially)		Forested (commercially)		Forested (commercially)	
Target trap nights	250	250	750	750	750	750
Unique raccoons	1	0	35	15	30[a]	38[b]
Recaptured raccoons	0	0	9	2	15	3
Non-target captures[c]	8	13	19	10	37	46
Area (km^2)	2.52	2.39	3.20	3.00	3.20	3.00
Raccoon density index[d]	0.4	0.0	10.9	5.0	9.4	12.7

[a] Sixteen raccoons were captured in the first sampling period, but were unique to the second sampling period.
[b] Nine raccoons were captured in the first sampling period, but were unique to the second sampling period.
[c] May include non-target captures and traps that were otherwise unavailable to capture a raccoon (sprung, stolen, etc.).
[d] Unique raccoons/km^2.

Post-ORV Monitoring

Birmingham Spring.--Sampling in the Birmingham Spring ORV zone was initiated on 14 May 2007 and conducted 8 weeks post-ORV. Cage traps were used to capture 125 unique raccoons, 1 gray fox, and 1 red fox from Bibb, Chilton, Jefferson, Perry, Shelby, and Tuscaloosa Counties. Blood and tooth samples were collected from most of them and all but 3 raccoons were immobilized, processed and released. One raccoon was euthanized due to a potential human exposure and 2 were found dead in traps; they all tested negative for rabies.

Birmingham Fall.--Sampling in the Birmingham Fall ORV zone was initiated on 7 December 2007 and conducted 9-10 weeks post-ORV. Cage traps were used to capture, immobilize, process and release 137 unique raccoons from Bibb, Chilton, Jefferson, Shelby, and Tuscaloosa Counties.

Georgia-Alabama-Tennessee.--Sampling for Alabama's GAT ORV zone was initiated on 3 December 2007 and conducted 9 weeks post-ORV. Cage traps were used to capture 128 unique raccoons and 1 gray fox from DeKalb County. Blood and tooth samples were collected from most of them and all but 2 raccoons were immobilized, processed and released. One raccoon was euthanized at a landowner's request and 1 died under anesthesia; they both tested negative for rabies.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 136 opossums (*Didelphis virginiana*), 8 domestic/feral cats (*Felis catus*), 4 cotton rats (*Sigmodon hispidus*), 2 armadillos (*Dasypus novemcinctus)*, 2 gray foxes, 1 Eastern box turtle (*Terrapene carolina*), and 1 red fox. Eight opossums were captured and euthanized by WS in 2007.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Alabama cooperates with the ADPH Bureau of Clinical Laboratories and the CDC.

Alabama Department of Public Health Bureau of Clinical Laboratories.--The ADPH tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). The ADPH confirmed 80 rabies cases in Alabama in 2007: 47 raccoons, 20 bats (*Chiroptera* spp.), 11 foxes, 1 dog (*Canis lupus familiaris*), and 1 opossum. For more information on rabies in Alabama go to: http://www.adph.org/ and type "rabies" into the search engine.

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA).

In 2007, the CDC tested 19 wildlife brainstem samples submitted by Alabama WS for confirmation of the dRIT results. Alabama WS also submitted 127 blood serum samples for rabies VNA analysis to the CDC in 2007. An additional 372 serum samples were collected in 2007 and will be submitted to the CDC in 2008. The Alabama ORV program anticipates a similar number of brainstem and serum sample submissions to CDC in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2006 and 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here as well.

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and teeth are analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In the 2006 annual report, results were missing for 61 serum samples collected during density studies and for all teeth collected in 2006. The teeth were submitted to Matson's Laboratory LLC (Milltown, Montana, USA) in August 2007 for age and tetracycline analysis, but were still pending at the time of this report. The sera will be submitted to the CDC in June 2008.

In 2007, WS collected sera from 499 animals (496 raccoons, 2 gray foxes, and 1 red fox) during enhanced surveillance, and post-ORV and ORV naïve trapping activities. Serology from post-ORV trapping in the Birmingham Spring ORV zone was available at the time of this report, but all other serology, age, and tetracycline was pending. Of 125 raccoon samples from the Spring ORV zone, 87 (69.6%) demonstrated a presence of rabies VNA, while 1 gray fox (100%) showed rabies antibodies. The one red fox captured did not have any detectable rabies antibodies. The raccoon serology in the Birmingham zone was up considerably from previous years: 36.6% in fall 2006; 22.1% in spring 2006; and 20.0% in fall 2005.

SUMMARY

The fall of 2007 marked the seventh year of WS cooperative participation in rabies management in Alabama. Work emphasized surveillance of raccoon rabies west and north of the Alabama and Coosa Rivers as well as ORV naïve and post-ORV monitoring and evaluation. Oral rabies vaccination efforts were continued in Birmingham and its surrounding counties and in northeast Alabama in an attempt to stop the westward movement of the raccoon variant from southeast Alabama and northwest Georgia. Future ORV baiting strategies in Alabama will continue to be directed towards halting the spread of raccoon rabies into western Alabama and beyond. These ORV zones will be tied to a national planning effort to contain the disease and explore strategies to eliminate the raccoon variant of the rabies virus from North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
ARIZONA 2007

BACKGROUND

Striped skunk (*Mephitis mephitis*) and gray fox (*Urocyon cinereoargenteus*) are the primary reservoirs of terrestrial rabies in Arizona. The South Central skunk variant of rabies typically occurs in the southeastern counties of Arizona. The Arizona gray fox variant generally extends through the eastern counties and central part of the state, along the Mogollon Rim. Bat rabies variants occur throughout the state. In 2001, a skunk was infected with a bat variant causing an unprecedented rabies outbreak in Flagstaff (Coconino County). By year's end, this rare spillover had infected 19 rabid skunks and was the first documented event of a bat variant of rabies being transmitted and maintained in skunks. This spillover reoccurred in late 2004 and again in 2005, prompting a trap-vaccinate-release (TVR) campaign by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) in Flagstaff. This campaign continued opportunistically throughout 2006 and 2007 (Figure 1).

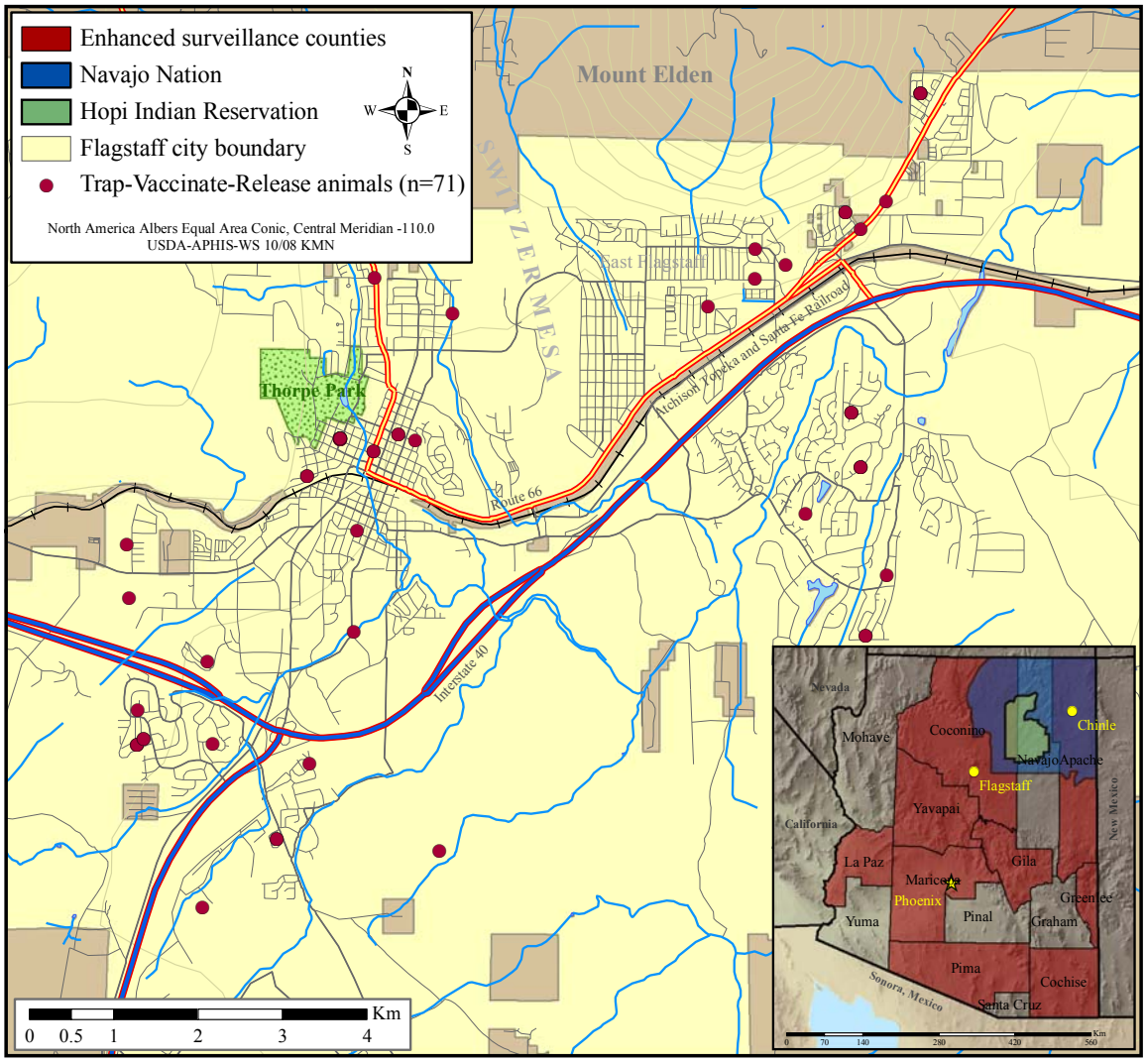

Figure 1. Wildlife Services cooperative rabies management program activities in Arizona, 2007.

In 2007, the Arizona Department of Health Services (ADHS) tested 2,476 animals and confirmed 159 cases of rabies, a 13.6% increase in positive cases from 2006. The 2007 rabies cases occurred in 11 of the 15 counties in

Arizona (Table 1). Approximately 76 domestic animals and 55 humans were exposed to these lab confirmed rabies positive animals. For more information on animals tested from Arizona in 2007 by the ADHS please visit: www.azdhs.gov/phs/oids/vector/rabies/stats.htm

Table 1. Animals confirmed positive for the rabies virus by the Arizona Department of Health Services in Arizona, 2007.

County	Bat	Skunk	Fox	Coyote	Bobcat	Total
Cochise	3	4				7
Coconino	4		3			7
Gila	10		8	1[a]	2[a]	21
Graham	1					1
Greenlee			7		1[a]	8
Maricopa	16				1[a]	9
Navajo	1					1
Pima	71	4	3		1[a]	79
Pinal	4	2	1			7
Santa Cruz		3				3
Yavapai	3		2		1[a]	6
Total	115	13	24	1	6	159

[a] Arizona gray fox variant of rabies.

RABIES MANAGEMENT PROGRAM 2007

Operational Assistance

Wildlife Services continued to assist with localized outbreaks of the Arizona gray fox rabies variant in Greenlee and Apache Counties. A total of 14 gray foxes and 2 bobcats tested positive in 2007 with a documented spread of lab-confirmed Arizona gray fox rabies into western New Mexico.

Wildlife Services also cooperated with the Southeastern Cooperative Wildlife Disease Study on a project designed to determine the prevalence (or presence) of *Trypanosoma cruzi* in wildlife species in Arizona and Georgia. *T. cruzi* is a protozoan parasite and is the causative agent for Chagas disease. Excess sera from feral dogs (*Canis lupus familiaris*) euthanized during oral rabies vaccination (ORV) post-bait trapping campaigns was used for this collaboration. None of the 20 free-ranging dogs tested were sero-positive for *T. cruzi*. A manuscript will be prepared for publication in Vector-Borne and Zoonotic Diseases in mid-2008 and Arizona WS personnel are co-authors on this paper.

In addition, WS cooperated with USDA, APHIS, International Services employees to assist with the Mexico/U.S. joint vampire bat (*Desmodus rotundus*) capture training in San Luís Potosí, Mexico. Two WS employees from the National Wildlife Research Center, four employees from the Arizona WS Program, one Navajo Nation employee and one employee from the Arizona Game and Fish Department attended the exercise. The training consisted of mist netting techniques for bats, the use of vampiricide, and captures of bats in and around caves, pastures, and feedlots. Some of the captured vampire bats were treated with vampiricide to assist with control efforts associated with the bovine paralytic rabies campaign. In addition, some bats were held for rabies testing and each captured vampire bat had biological material collected for genetic determination.

Hand Vaccination (Trap-Vaccinate-Release [TVR])

In a continuing effort to reduce the number of confirmed rabies cases in Arizona, and particularly Flagstaff, WS cooperated with the Centers for Disease Control and Prevention (CDC), the ADHS, the Coconino County Health Services (CCHS) and numerous local nuisance wildlife control operators to trap, vaccinate (using Rabdomun®, [Schering-Plough Animal Health Corporation, Summit, New Jersey, USA]), and release 68 animals in 2007 (Figure 1). These hand vaccinated animals included: 65 striped skunks (including 2 recaptures from previous years) and 3 raccoons (*Procyon lotor*). It is anticipated that this project would be completed in early 2008 if the World Health Organization's 2-year rabies free standard is met in terrestrial wildlife in Flagstaff.

All animals captured by WS in 2007 were done so in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

A presentation summarizing the TVR efforts entitled "Trap-Vaccinate-Release to Manage Rabies Outbreaks in Striped Skunks in Flagstaff, Arizona, USA" was presented at the joint Arizona/New Mexico Wildlife Society conference in Albuquerque, New Mexico in February 2007.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Wildlife Services used the dRIT on 278 animals, from 9 counties (Figure 1), to enhance rabies surveillance in 2007: 243 feral/free-ranging dogs, 12 gray foxes, 10 striped skunks, 9 coyotes (*Canis latrans*), 1 bobcat (*Felis rufus*), 1 mule deer (*Odocoileus hemionus*), 1 rabbit (*Sylvilagus audubonii*), and 1 raccoon. All but 1 of the dRIT samples tested negative and 10% of the samples were sent to the CDC for confirmation. One gray fox sample from Apache County tested positive and was submitted to the ADHS and the CDC for confirmation. ADHS and the CDC (using the dFA test) had 100% agreement with the WS dRIT results. The dRIT surveillance testing was conducted in Chinle, Arizona on the Navajo Nation and in the state office located in Phoenix, Arizona. Samples outside of the Navajo Nation were collected mainly through cooperation with local predator callers clubs or from other WS personnel. Wildlife Services will continue to use the dRIT to enhance surveillance of suspect rabid animals in Arizona.

RABIES-RELATED RESEARCH STUDIES 2007

In many areas of the world, only 30-50% of dogs are vaccinated against rabies. On some U.S. Indian Reservations, vaccination rates are estimated to be much lower at only 5-20%. There are many factors such as lack of interest, cost or availability of effective vaccines, or cultural differences in dog ownership which lead to these low vaccination rates. Oral baits and vaccines in use for rabies control programs for wildlife are potential methods to target free-ranging dogs which could not otherwise be vaccinated by more conventional means. Therefore, WS continues to evaluate the potential for use of ORV to vaccinate feral/free-ranging dogs on the Navajo Nation in northern Arizona (Figure 1 inset).

In addition to the progress being made with ORV use in free-ranging dogs, WS began examining the prevalence of rabies virus neutralizing antibodies (VNA) in free-flying bats in Arizona and began a study to determine the rabies vaccine efficacy in gray wolves, specifically the Mexican gray wolf (*Canis lupus baileyi*). Due to poor serology results from 2006, WS discontinued the skunk ORV research in Flagstaff until alternative vaccines and/or bait matrices are available.

Feral Dog ORV Bait Study

In May 2007, WS conducted a third field trial using fishmeal-coated sachet (CS) baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) on feral free-ranging dogs on the Navajo Nation in conjunction with the CDC and the Navajo Nation Veterinary Program. This study followed an ORV placebo bait study on the Navajo Nation during 2003 and 2004. The 2003/2004 study evaluated the acceptance of 4 commercially available bait matrices: a vegetable shortening-based and coated blister pack (Ontario Slim bait, Artemis Technologies, Inc., Guelph, Ontario, Canada), a fishmeal-crumble coated sachet (CS, Merial Ltd.), a dog food polymer (Bait-Tek, Inc., Orange, Texas, USA) and a fishmeal polymer (Bait-Tek, Inc.). Each bait matrix included a blister pack or plastic sachet filled with water. A total of 741 dogs were offered one of the placebo baits with acceptance ranging from 30.7% for the dog food polymer to 77.8% with the CS. There were two functional response categories for dog handling behavior of each bait: handled with potential oral contact with placebo vaccine and handled without potential oral contact to placebo vaccine. The functional response to the Ontario Slim was significantly reduced when compared to the polymer baits and in turn, the polymer baits were less preferred than the CS's. The greater acceptance of placebo vaccine in CS baits during the 2003 and 2004 study led to the initial ORV field trial in 2005 using CS baits containing Raboral V-RG® vaccine. Results of this placebo bait study were

published in the proceedings of the Joint OIE/WHO/EU International Conference "Towards the Elimination of Rabies in Eurasia" held in Paris, France in May 2007 (Bergman, et al. 2008).

This was the first field trial of its kind specifically targeting feral dogs in the U.S. The 2007 study was a continuation to field test an oral rabies vaccine and determine rabies titer levels in feral dogs that may have been exposed to the vaccine. In 2006 and 2007, a microencapsulated tetracycline biomarker was added to the fishmeal coating of CS baits to determine if dogs sampled during post-bait round-ups were exposed to the baits.

Study Areas.--Sites in and around Chinle, Arizona on the Navajo Nation were chosen as the areas to distribute ORV baits (Figure 1 inset).

Methods.--Groups of 2-4 people, which included at least 1 representative from the Navajo Nation, hand baited as many dogs as possible. Each dog was presented a CS bait containing the tetracycline biomarker from a person's hand or a CS bait was tossed in a dog's direction if he was suspicious of eating out-of-hand. Personnel recorded numbers and sex of each dog, and how the dogs reacted to the bait: ignored the bait; took it and discarded it; swallowed it whole; chewed it but spilled the vaccine; or chewed it and received a vaccine dose. In total, 366 CS baits were distributed to 354 dogs (198 males, 147 females, 9 not recorded) with 183 (51.7%) of those dogs potentially receiving a vaccine dose.

Starting 6 weeks after baiting and continuing for 6 months post-ORV bait distribution, the Navajo Nation Animal Control (NNAC) collected 63 feral dogs during their routine dog control "round-ups" (all from the baited area). All the dogs were bled and subsequently euthanized by the NNAC and serum samples from each dog were sent to the CDC to be analyzed for rabies VNA.

Results.--Serum samples were collected from 63 dogs rounded-up in the ORV baited area; 17 of the 63 samples (27.0%) had detectable levels of rabies antibodies (titer ≥0.05 IU) with 2 having a titer >0.49 IU. Tetracycline results were pending at the time of this report.

In 2005, 253 dogs were fed CS baits containing Raboral V-RG®. Forty dogs were sampled during post-bait round-ups and 5 individuals (12.5%) had a positive rabies VNA response.

In 2006, 373 dogs were fed CS's containing Raboral V-RG®. In addition to the normal bait coating, microencapsulated tetracycline was added to the fishmeal crumble to serve as a biomarker. One hundred and four dogs were sampled during post-bait round-ups; 33 individuals (31.7%) had detectable rabies VNA. In addition, 18 of the 104 animals were tested for the presence of tetracycline. Four of the 18 animals (22.2%) had biomarker present in premolar tooth samples, with only 1 individual positive for both biomarker and rabies VNA in 2006.

Even though the primary acceptance criteria of detecting VNA in >50% of dogs tested was never reached in 3 years of field trials, it is beneficial to the development of the vaccine/bait delivery system to continue distributing ORV to feral/free-ranging dogs on the Navajo Nation. This study is planned to continue in 2008.

Oral Rabies Vaccine Titer Study with Captive Dogs on the Navajo Nation

In 2005, CS baits containing Raboral V-RG® vaccine were administered to 6 captive dogs to quantify the serological response following a single exposure to the vaccine. None of the animals developed a positive rabies VNA response (titer ≥0.05 IU) as determined by the rapid fluorescent focus inhibition test (RFFIT). In 2006 the study was expanded to quantify serological response following administration of the raccoon field dose of Raboral V-RG® over single and multiple days to a mixed population of captive dogs. Additionally, this study aimed to quantify the amount of human exposure risk to the vaccinia virus associated with animals recently exposed to Raboral V-RG®.

Study Areas.--All feral dogs were obtained during round-ups conducted by the NNAC from areas in and around Chinle, Arizona.

Methods.--To quantify the serological response following administration of CS baits containing Raboral V-RG®, 24 dogs were placed into one of 4 groups. Each group consisted of 6 dogs and received one of the following treatment regimes: Group 1, Raboral V-RG® given once; Group 2, Raboral V-RG® given twice (once each on 2 consecutive days); Group 3, Raboral V-RG® given 3 times (once each on 3 consecutive days), and Control, no treatment. Sera were collected from each animal at the start of the study and again on day 30 to determine rabies antibody levels. One dog in Group 2 died of natural causes prior to the completion of the study so the sample size for that group was decreased by 1 (n=5).

Whole blood was collected into a serum separator tube via vena puncture and centrifuged at a minimum of 2,000 rpm for 10 minutes to obtain serum. Sera were frozen immediately in a -70°C freezer where they were stored until shipped to the CDC for analysis. Because Raboral V-RG® contains live vaccinia virus, there is a potential for human exposure if the vaccinia persists in the oral cavity following administration of the CS bait. To determine how long vaccinia is present following administration of the CS, each dog had its tonsils swabbed approximately 3 hours after administering the final Raboral V-RG® sachet and continuing for a total of 5 days. Swabs were collected using sterile cotton-tipped swabs which were placed in BHI media and frozen at -70°C.

Results.--None of the 6 dogs in Group 1, Raboral V-RG® given once, developed a positive rabies VNA response. None of the dogs in this group had rabies VNA prior to the administration of Raboral V-RG®. All oral swabs tested negative for the presence of vaccinia virus.

Two of 5 dogs (40%) in Group 2, Raboral V-RG® given twice (once each on 2 consecutive days), developed positive rabies VNA responses. One dog in this group died prior to day 30 of the trial and a blood sample was not collected for analysis. As with the previous group, none of the dogs in this group had rabies VNA prior to administration of Raboral V-RG®. All oral swabs tested negative for the presence of vaccinia virus.

Three of 6 dogs (50%) in Group 3, Raboral V-RG® given 3 times (once each on 3 consecutive days), developed positive VNA responses. As with the previous groups, none of the dogs in this group had rabies VNA prior to administration of Raboral V-RG®. All oral swabs tested negative for the presence of vaccinia virus.

None of the 6 dogs in the Control group, receiving no coated sachets containing Raboral V-RG®, developed positive rabies VNA responses. One of the dogs in this group had rabies VNA prior to the start of the study, but the antibody response was no longer measurable after the 30-day study period. All oral swabs tested negative for the presence of vaccinia virus.

Although more research is necessary, our results indicate that the standard dose of vaccine in CS baits (2 ml's of Raboral V-RG®) is ineffective at producing VNA in dogs after only a single dose. There is potential that multiple, consecutive doses could prove to be effective, however it is unlikely that feral/free-ranging dogs could be vaccinated successfully given the challenges to administering baits to the same dogs on multiple days. Further testing and evaluation needs to be conducted to determine the minimum effective dose for dogs. However, should a product become available with a higher dosage of vaccine, an alternative product, or different packaging, it could prove effective for use with feral/free-ranging dogs.

Prevalence of Rabies Antibodies in Free-Flying Insectivorous Bats in Arizona

In June 2007, the Arizona WS program partnered with the Arizona Game and Fish Department to begin sampling free-flying insectivorous bats in Arizona for the presence of rabies virus particles in the saliva and VNA in the serum.

The rabies virus is virtually global in distribution and the mammalian orders *Carnivora* and *Chiroptera* are its principal hosts, with bats acting as a primary reservoir on all inhabited continents (Rupprecht et al. 2002 and references therein). Molecular characterization of rabies has revealed multiple unique rabies virus variants circulating within bats (Smith 1996, Nadin-Davis et al. 2001, Shankar et al. 2005). Thus, the highly diverse bat fauna of the New World (9 families and more than 250 species) hosts an equally diverse group of rabies virus variants.

As vaccination programs have reduced rabies in terrestrial carnivores (De Mattos et al. 2000, Rupprecht et al. 2002) bats will continue to provide an important ecological niche in which rabies will persist, diversify and provide a source for new variants. Additionally, although human rabies deaths in the U.S. are quite low, in recent decades, bat-associated variants of rabies have been responsible for most cases (Smith 2002). Urbanization and changing landscapes continue to put bats and humans in direct contact, suggesting a continued risk. Consequently, understanding rabies and its distribution in bat species is of increasing importance. The fear of rabies and our lack of knowledge about its distribution and prevalence in bat species make them targets of control based on fear. Therefore an examination of rabies prevalence, distribution, and diversity in wild bat populations will serve to inform management and control efforts that aim to protect humans from this untreatable, fatal disease.

The potential for human exposure to rabies from big brown bats (*Eptesicus fuscus*) is perhaps higher than for any other species of bat in the United States, due to the propensity for this species to roost in buildings in urban and suburban settings (Pape et al. 1999, Kunz and Reynolds 2003). Big brown bats constituted the greatest proportion of bats tested in public health surveillance programs in the U.S. (67% of 31,380 bats submitted over an 8 year period, Mondul et al. 2003) and human death from rabies virus variants associated with big brown bats has been reported in the U.S. (Smith 2002). However, most human rabies deaths in the past decade are linked to 2

rabies variants associated with the silver-haired bat (*Lasionycteris noctivagans*) and the eastern pipistrelle (*Pipistrellus subflavus*; Messenger et al. 2003, Krebs et al. 2000). Consequently, improved understanding of prevalence and patterns of rabies in these species are needed to understand matters of public health and to help manage for bats. This pilot study will allow us to determine if we can adequately sample those bats often associated with rabies virus variants causing human death.

In order to understand the diverse variants and patterns of rabies virus in bats, it is important to sample across a range of bats with varied life history patterns. For example, big brown bats are colonial and short-distance migrators, whereas silver-haired bats are generally solitary and longer distance migrators. We propose to sample as many insectivorous bat species as possible to better understand how life history traits affect rabies prevalence.

As rabies virus has diversified in New World bats, it has also moved from bats into other groups of mammals. The potential for spread of bat rabies into other species that have high rates of human interactions or live in urban areas increases the potential for human fatalities from rabies. The spillover of bat rabies into terrestrial species may be of particular importance in Arizona. In 2001, a striped skunk was infected with a rabies virus variant associated with big brown bats causing an unprecedented rabies outbreak in Flagstaff, Arizona. By the end of 2001, this rare spillover had infected 19 skunks and was the first documented event of a bat variant of the rabies virus being transmitted and maintained in skunks (Engeman et al. 2003, Leslie et al. 2006). Other animals have also tested positive for the bat variant in Arizona. In 2005, 84 bats from Arizona tested positive for rabies and in 2006, 96 bats tested positive, with one being found in the highly visited Slide Rock State Park north of Sedona, Arizona.

A recent multi-year study in Fort Collins, Colorado examined the dynamics of rabies in urban big brown bats. They collected data on seroprevalence of rabies virus neutralizing antibodies (blood samples) and the frequency of infectious individuals (the prevalence of rabies viral genome in saliva obtained through oral swabs), and examined the associated patterns of variation among individuals and colonies (O'Shea et al. 2004). They captured bats at known maternity roosts, individually marked bats, and collected blood and saliva samples to conduct this multi-year serological survey (Ellison et al. 2006, Wimsatt et al. 2005). Preliminary findings show that in a sample of over 2,000 bats from multiple colony sites, seropositive bats were found in every maternity colony sampled and 20-25% of adult females were found to be seropositive. Seropositive bats were known to be alive 1-3 years later and antibodies persisted 1-2 years after the first sampling, potentially indicating that bats exposed to rabies can acquire immunity (O'Shea et al. 2004). Additionally, preliminary data have found no evidence of rabies virus in saliva or tissue of seropositive bats (O'Shea et al. in press). Finally, big brown bats and 6 other species were sampled elsewhere in Colorado and New Mexico, all groups included seropositive individuals (O'Shea et al. 2004). This study poses a number of hypotheses that can be further elucidated by sampling bats from other ecosystems, comparing species using urban vs. non-urban roosts, and sampling a wider diversity of species.

In this multi-year study we propose to use methodologies described in Ellison et al. (2006) and Wimsatt et al. (2005). This will allow for a direct comparison of results among the differing ecosystems. Because Arizona has a high diversity of bat species – 28 different species reside in the state for at least a portion of each year – we will be able to sample from a variety of bats with widely varying life history traits (i.e. colonial or solitary, migratory or nonmigratory). By comparing the data collected in Arizona, we may be able to clarify differences between rabies prevalence in urban settings (Ft. Collins study) and that in sub-urban or rural settings.

Rabies concerns are high in Arizona due to the spillover events that have recently occurred in Flagstaff. There are also numerous terrestrial rabies outbreaks occurring in varied parts of the state including: the Blue River Range on the border of Apache and Greenlee Counties and in Pima country near Tucson. These recent outbreaks and human exposures have increased public awareness of the disease and concerns over public health and safety. Arizona is an ideal location to conduct this study due to the prevalence of numerous species of bats along with a dedicated network of bat biologists with the expertise in capturing and handling many species of bats. The Arizona Game and Fish Department agreed to partner with WS and the CDC to obtain and analyze the samples.

Objectives.--In this multi-year study, we plan to collect serum and saliva samples from Arizona bats to determine rabies antibody levels and for rabies polymerase chain reaction screening, respectively, in order to:

1. Determine prevalence of rabies virus neutralizing antibodies in free-flying bat species through a serological survey of captured bats;
2. Gain a better understanding of rabies exposure rates in different species of bats with varied life history traits;
3. Gain a better understanding of how the rabies virus circulates in natural populations and how this might relate to spillover events (bat rabies in other terrestrial carnivores, such as skunks); and
4. Compare rabies exposure rates in bats collected from an urban versus non-urban setting.

Study Areas.--Bats were sampled from diverse locations around Arizona including sites in the Sonoran desert, the Chiricahua mountains, ponderosa pine forest on the Mogollon Rim, riparian areas, and stock tanks.

Methods.--Bats were captured using mist nets, funnel traps or harp traps beginning at approximately sunset and continuing for at least 3 hours. Each bat was assessed for age, weight, sex and reproductive status. Two sterile cotton swabs dipped in virus isolation media (MEM-10) were inserted into the mouth to collect samples for rabies polymerase chain reaction screening. The samples were frozen in MEM-10 and Trizol media at -70°C until shipped to the CDC for analysis. Collection of blood was made by first warming the tail membrane on a hot water bottle until uropatagial vein engorgement was evident. The uropatagial vein was lanced and blood was collected in microcapillary tubes. The goal was to collect less than 1% of the total body weight in blood volume from each bat, but collect at least 75 µl to ensure adequate serum sampling. Direct pressure, cold packs, and/or hemostatic gel were used to ensure hemostasis. Blood was kept cool until being centrifuged at the end of each sampling night. Sera were stored at -70° C until assayed.

All samples were processed by the CDC in Atlanta, Georgia. RNA was extracted from oral swab samples and analyzed for the presence of rabies virus genomic material using RT-PCR (Shankar et al. 2004). The RFFIT was used to determine VNA presence in each sample.

Results.--A total of 282 bats were captured including 16 unique species from 11 locations in Arizona. Of the 282 bats, saliva samples were collected and analyzed from 270 individuals. Viral amplicons were detected in one sample from a western pipistrelle (*Pipistrellus hesperus*), but subsequent virus isolation attempts in suckling mice and in cell culture were unsuccessful. Serum samples were collected and analyzed from 205 of the 282 bats captured. Only bats from species averaging 7g or more in body weight were sampled for serum. Eighteen of the 205 bats (8.8%) sampled tested positive for rabies VNA. The species with the highest seroprevalence during this pilot year was the big brown bat with nearly 14% of the sampled bats positive for rabies VNA. Results from this multi-year study will help us to better understand bat rabies in wild populations. This study is planned to continue in 2008.

Rabies Vaccine Efficacy in Gray Wolves

In the summer of 2007, the Arizona WS program partnered with the U.S. Fish and Wildlife Service and the captive wolf facilities participating in the Mexican Wolf Species Survival Plan to begin a study aimed at determining the efficacy of canine rabies vaccines in gray wolves (*Canis lupus*) especially the Mexican wolf subspecies (*C. lupus baileyi*). The canine variant of the rabies virus has been eliminated from the U.S. through vaccination efforts with domestic animals (Centers for Disease Control and Prevention 2007). However, rabies outbreaks have been documented with wild canine species, including gray wolves (Theberge et al. 1994, Weller et al. 1995, Ballard and Krausman 1997). It has even been suggested that rabies is one of the most important diseases of wolves (Mech 1970).

Currently, there are no rabies vaccines labeled for gray wolves. Although rabies vaccines have been thought to work effectively in wolves (demonstrated by the fact that vaccinated wolves develop rabies antibodies after administration of the vaccine), no vaccinated wolves have been challenged with a virulent rabies strain. A variety of products have been used to vaccinate wolves against rabies. The objective of this study is to determine the efficacy of various rabies vaccines in gray wolves by correlating rabies antibody titer levels with the known vaccination history for each animal.

Methods.--Information relating to vaccination histories of each wolf were collected in order to interpret serum titer levels. Necessary data included: wolf ID, age, sex, general body condition, dates of vaccination, product used at each vaccination, route of administration of each vaccination, and the date of blood collection. Serum from each wolf was obtained during routine animal care procedures and sent to the CDC for analysis using the RFFIT procedure.

Results.--Serum and vaccination histories have been obtained from approximately 100 wolves at 10 institutions. Results from the RFFIT analysis were not available at the time of this report. Once the lab results are available, comparisons will be made with known vaccination histories of the animals to determine which vaccines are most effective at providing a rabies VNA response.

OUTREACH ACTIVITIES

September 8, 2007 marked the first World Rabies Day. To celebrate and promote World Rabies Day in Arizona, stickers and informational handouts were created and distributed to WS employees and cooperators throughout the state. Several no-cost vaccination clinics were available to Arizona residents through various agencies and these activities were promoted along with the distribution of World Rabies Day materials. Additionally, a presentation was given to the Phoenix Varmint Callers to increase awareness about World Rabies Day and promote safe practices to protect hunters from exposure to rabies.

SUMMARY

The Arizona WS program continues to be unique in that it is currently the only program specifically targeting feral dogs with ORV. Wildlife Services continues to be vigilant with its trap-vaccinate-release efforts to prevent rabies in wild skunks in Flagstaff. In 2007, WS began new research projects to gain information on vaccine effectiveness with Mexican gray wolves and to better understand the rabies exposure rates experienced by free-flying bats throughout Arizona. In the coming year, WS anticipates continued ORV bait distribution to suppress rabies in the feral dog population on the Navajo Nation. Wildlife Services will continue to provide support and respond to requests for assistance with rabies surveillance and management in Arizona. Wildlife Services looks forward to continuing a strong cooperative relationship with state and local agencies, while providing federal leadership in wildlife rabies management.

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WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
CALIFORNIA 2007

BACKGROUND

California has 2 variants of the rabies virus maintained in striped skunks (*Mephitis mephitis*) and bats (*Chiroptera* spp.). Rabies has remained enzootic in the skunk population since 1945. The skunk variant of rabies occurs in all areas of the state north of the Tehachapi mountain range and west of the Sierra Nevada crest (Figure 1). Rabies was first identified in a California bat in 1953 and has remained enzootic in the population since its detection. Rabies in raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), and various canids (*Canidae* spp.) occasionally occurs, but is not maintained in these species within the state. Rabies in these species likely represents a spillover from enzootic skunk or bat variants. From 1997-2006, the California Department of Health Services (CDHS) confirmed 2,788 cases of rabies in animals throughout the state (Figure 1).

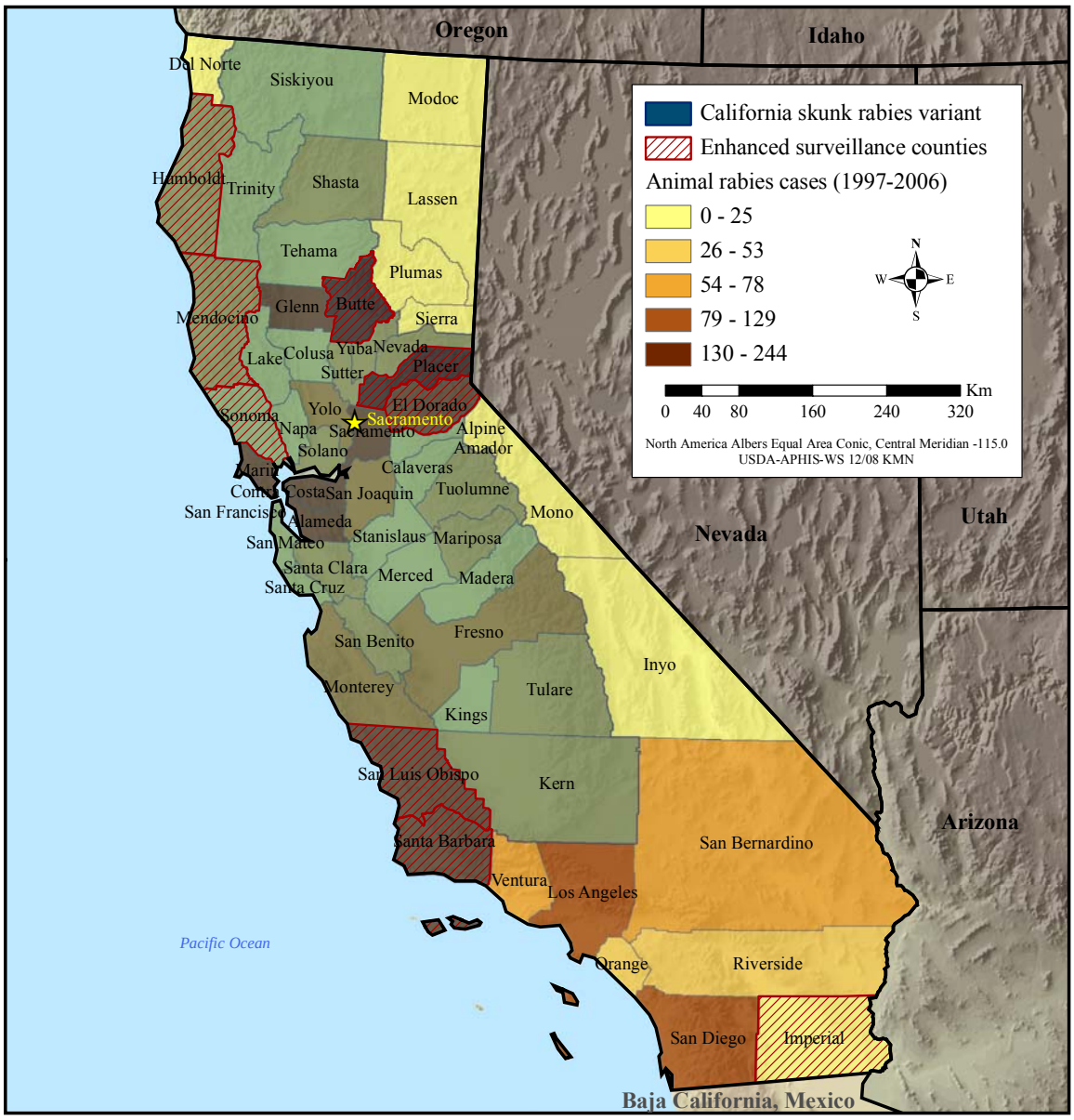

Figure 1. California skunk rabies variant distribution and animal rabies cases in California, 1997-2006.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

Currently, there is no oral rabies vaccine (ORV) licensed for use in skunks in the United States. In 2004, Wildlife Services (WS), in conjunction with its National Wildlife Research Center (NWRC) conducted placebo ORV bait research projects. This was part of a larger project primarily conducted in Arizona, Louisiana, Texas, and Wyoming. The goal was to compare various formulations of placebo baits and determine bait acceptance levels in skunks. The optimal bait formulation derived from these studies may eventually be used to deliver an ORV to skunks. Several vaccines are currently being evaluated in the laboratory and may be ready for field testing in the future. California WS participated in these past bait trials in an effort to obtain U.S. Department of Agriculture licensing for ORV in skunks.

Enhanced Surveillance

California WS removes animals from locations where human-animal interactions are high. These areas represent sites of potential human exposure to rabid animals where they occur. In 2007, WS personnel removed 5,030 skunks from throughout the state. Over 46% of the skunks removed were from 5 counties (Butte, El Dorado, Placer, San Luis Obispo, and Santa Barbara) identified as having a high prevalence of skunk rabies. All animals captured or taken by WS were evaluated for signs and symptoms of disease in the field prior to release or removal. Any animal exhibiting illness or unusual behavior was transported to the local health authority for testing. Unfortunately, there was no record kept of how many animals were submitted to local health laboratories, but WS did receive reports from some of these labs indicating that no rabies positives were detected in our samples. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Rabies Laboratory Cooperation

Rabies has been a legally required reportable disease under the California Code of Regulations, Title 17, Section 2500 since 1921. The CDHS, Veterinary Public Health Section is responsible for the surveillance, prevention, and control of rabies in California. Prior to 2007, only animals that exhibited behavior/circumstances consistent with rabies or were directly involved in a potential exposure incident were tested for rabies by the CDHS. In 2007, California WS began collaborating with the CDHS to increase the number and species of wild animals being tested for rabies. This program was named Enhanced Rabies Surveillance. In addition to testing sick and unusually behaving animals, WS provided 127 samples from presumed healthy skunks and gray foxes (*Urocyon cinereoargenteus*) in 9 counties: Butte, El Dorado, Humboldt, Imperial, Mendocino, Placer, San Luis Obispo, Santa Barbara, and Sonoma (Figure 1). Enhanced surveillance counties were selected by the CDHS based on analysis of historical rabies cases. All of the presumed healthy samples (127) tested negative for rabies. Wildlife Services and the CDHS will continue to modify the Enhanced Rabies Surveillance Program for the 2008 collection year.

In 2007, the CDHS confirmed 188 cases of rabies in animals: 152 bats, 26 skunks, 6 foxes, 2 raccoons, 1 cat (*Felis catus*), and 1 coyote (*Canis latrans*). In a 10-year period from 1997-2006, the CDHS reported 2,788 cases of animal rabies throughout the state. Infected skunks and bats represented 96.7% of all reported cases (1,065 and 1,630, respectively). Cases of rabies were also reported in: 43 foxes, 18 domestic/feral dogs (*Canis lupus familiaris*), 15 domestic/feral cats, 5 opossums, 3 raccoons, 2 cows (*Bos taurus*), 2 horses, 2 wolf-dog hybrids, 1 goat (*Capra aegagrus hircus*), 1 rabbit (*Sylvilagus audubonii*), and 1 sheep (*Ovis aries*). The CDHS also reported 6 cases of rabies in humans during this same 10-year period. Bat variants of rabies have been involved in most cases of human rabies infection. Currently, 11 of 24 bat species in California are listed as State Species of Special Concern. Due to the special status of such a large number of bat species, WS refers bat nuisance calls to the California Department of Fish and Game. For a full listing of reported rabies by county and species in California for 2007 and the last 10 years please visit: http://www.cdph.ca.gov/healthinfo/discond/Pages/rabies.aspx

Rabies cases by species and county in California for 2007 are within the average range of cases for the last 10-year period. Low numbers of cases in 10 counties may reflect a small sample size for submissions. Wildlife Services lacks an agreement to remove skunks in the majority of these counties.

SUMMARY

Wildlife Services personnel in California remain vigilant for clinical signs of rabies in their wildlife management activities. In addition to skunk removal activities and the possibility of future ORV studies, WS continues to educate the public about safety when living or working near wildlife through technical assistance and outreach activities.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
FLORIDA 2007

BACKGROUND

In 1947, raccoon (*Procyon lotor*) rabies was first documented in Florida and is now considered enzootic statewide. During the late 1970s raccoon rabies was translocated by raccoon hunters from Florida to the Mid-Atlantic States, where it began to spread throughout the eastern United States. In 1995, Pinellas County Animal Services initiated a county-wide oral rabies vaccination (ORV) program to combat an explosive outbreak of rabies in raccoons. This program continues today and over 600,000 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) have been distributed in the county since 1995 (Figure 1).

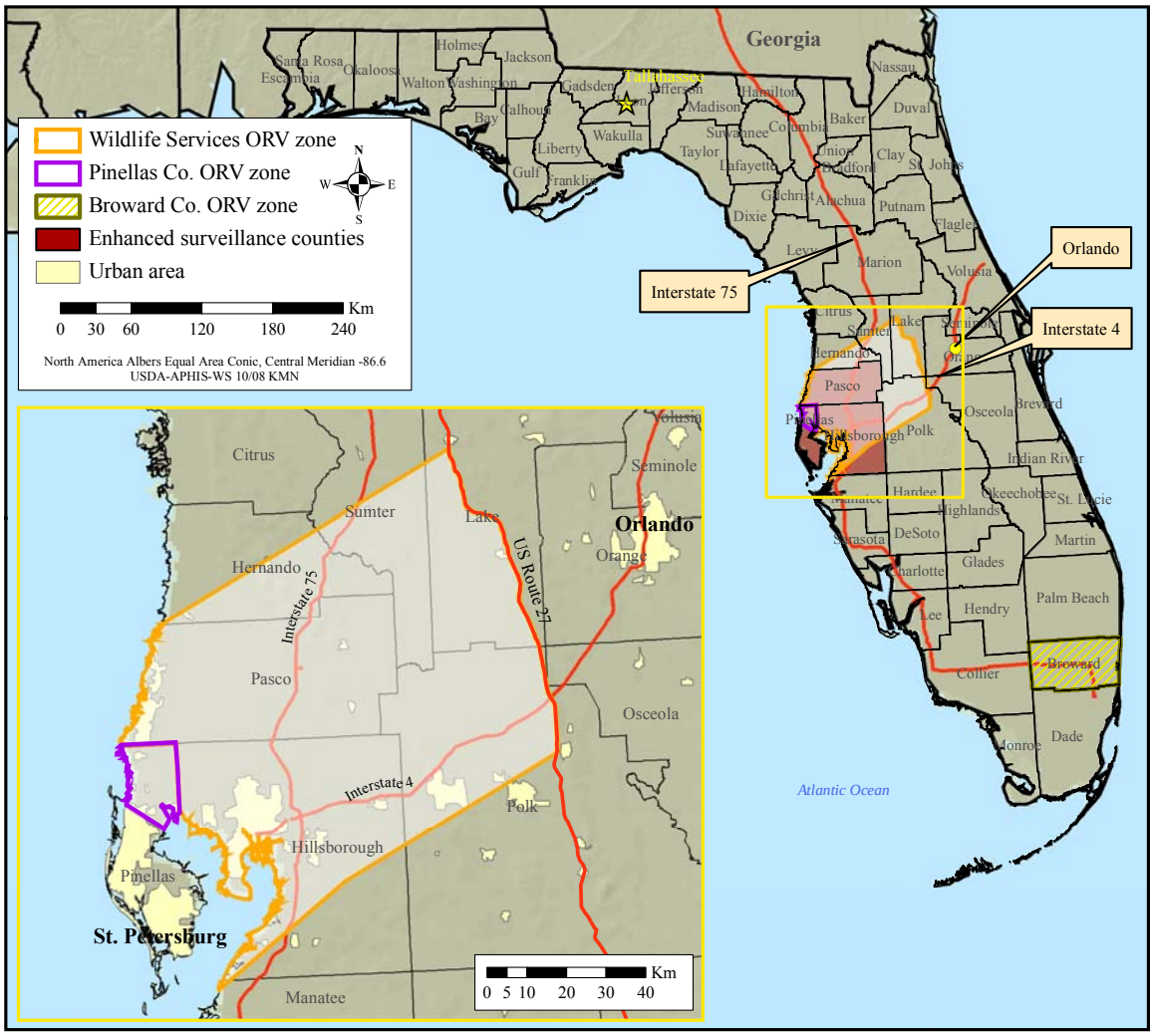

Figure 1. Wildlife Services cooperative rabies management program activities in Florida, 2007.

Wildlife Services (WS) began an ORV program on the Gulf coast in central Florida in 2003. The objective of the Florida WS Cooperative Rabies Management Program was to expand on the success of the Pinellas County ORV Program by establishing a vaccination zone in areas of high human population along the Interstate 4 corridor (Figure 1). The ORV program in Florida constitutes an important southern component in WS' National Rabies Management Program (NRMP).

In 2007, WS worked cooperatively with the Florida Department of Health (FDH), the Florida Fish and Wildlife Conservation Commission, the Southwest Florida Water Management District, and the Florida Park Service

on the Florida ORV Program. In addition, WS gained the support of many county and city agencies to aid with the planning and the implementation of 2007 ORV bait distribution efforts.

ORV PROGRAM 2007

Bait Distribution

For the fifth consecutive year in 2007, WS participated in bait distribution efforts throughout central Florida; 540,825 baits containing Raboral V-RG® vaccine were distributed over 7,655 km^2 (2,956 mi^2). The ORV zone included portions of Hernando, Hillsborough, Lake, Pasco, Pinellas, Polk, and Sumter Counties. During 14-17 February bait distribution efforts, 183,600 fishmeal polymer (FMP) baits were distributed by fixed-wing aircraft, 280,905 FMP baits by hand, and 76,320 FMP baits by helicopter (9,465 of those in Pinellas County).

In 2007, aerial bait distribution occurred at a rate of 75 baits/km^2 across the entire bait zone (Figure 1). Aircraft and pilots for the ORV program were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA). Helicopters and pilots were provided by Hillsborough County Mosquito Control, Pasco County Mosquito Control, and Polk County Sheriffs Department. Ground and aerial baiting support were provided by WS, and county and municipal agencies. Since its program inception in 2003, WS has distributed 3,009,581 ORV baits in Florida.

Broward County.--In 2005, a 5-year ORV program initiated by the Broward County Commission began as part of their overall Rabies Prevention Campaign to limit the spread of raccoon rabies in the county. The effort is led by the Broward County Animal Care and Regulation, and Parks and Recreation Divisions. Over 200,000 baits are distributed throughout the county annually (Figure 1). In 2007, 201,179 FMP baits were distributed by the following methods: 158,395 by hand; 29,880 by helicopter, and 12,904 by boat. Wildlife Services provided guidance to Broward County officials (via video) on ORV bait handling and placement techniques for hand distribution. No further requests for assistance were made by Broward County officials.

Enhanced Surveillance

Wildlife Services and cooperators collected 125 animals for enhanced rabies surveillance in 2007: 124 raccoons and 1 feral cat (*Felis catus*). Of those raccoons, 105 were collected from a population reduction program to protect Threatened & Endangered Species in a Pinellas County park; 12 and 4 strange-acting raccoons were submitted by Pasco and Hillsborough Counties Animal Services, respectively; and 3 were collected by Polk County landowners due to nuisance reasons. Two raccoons from Pasco County tested positive for rabies; all others were negative.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Florida WS personnel attended dRIT training in late 2007 and another will attend in early 2008 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

Post-ORV Monitoring

From March to May 2007, WS conducted post-ORV trapping in Hernando, Hillsborough, Lake, Pasco, Polk, and Sumter Counties. Using cage traps, 191 raccoons and 2 feral cats were trapped. Tooth and blood serum samples were collected from most raccoons and both cats. Teeth were sent to Matson's Laboratory LLC (Milltown, Montana, USA) for age and tetracycline biomarker analysis, while sera were sent to the CDC for rabies virus neutralizing antibody (VNA) testing. Both cats and 2 raccoons were euthanized at landowners' requests, 1 raccoon was euthanized due to a severe case of mange, and the remaining 188 were immobilized, processed and released. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals

euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Non-target Captures

In 2007, 164 opossums (*Didelphis virginiana*) were captured and released, while 2 feral cats were euthanized during post-ORV sampling at landowners' requests.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Florida cooperates with the FDH Laboratory (FDHL) and the CDC.

Florida Department of Health Laboratory.--The FDHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Animal Control Officers). The FDHL tested 3,479 animals for the rabies virus in 2007 (Table 1), representing a 3.2% decrease from the number of samples tested statewide in 2006. Animals were submitted from all 67 counties throughout the state, including the 7 ORV counties and 9 adjacent counties: Charlotte, Citrus, De Soto, Hardee, Highlands, Lee, Manatee, Osceola, and Sarasota. Of the animals tested statewide, 39.6% came from within or adjacent to the ORV zone, representing a 4.1% decrease from the number of samples tested within or adjacent to the ORV zone in 2006. The FDHL confirmed 128 cases of rabies in Florida in 2007: 64 raccoons, 20 foxes (*Urocyon* or *Vulpes* spp.), 18 bats (*Chiroptera* spp.), 14 cats, 4 bobcats (*Lynx rufus*), 4 otters (*Lutra canadensis*), 2 skunks (*Mephitis mephitis*), 1 dog (*Canis lupus familiaris*), and 1 horse (*Equus caballus*).

Raccoons, skunks, foxes, coyotes (*Canis latrans*), and bobcats are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 80.2% of the animals tested for rabies in Florida in 2007 are reported by WS as "other." For a full listing of animals tested from Florida in 2007 by the FDHL please visit: http://www.doh.state.fl.us/Environment/community/rabies/rabies-charts.htm

Table 1. Animals tested for rabies by the Florida Department of Health Laboratory via the public health surveillance system in Florida, 2007 (number of rabies positives and percent positive in parentheses).

	Statewide	Within and adjacent to Florida ORV zone
Raccoons	587 (64, 10.9%)	189 (13, 6.9%)
Skunks	7 (2, 28.6%)	3 (0)
Foxes	78 (20, 25.6%)	17 (3, 17.6%)
Coyotes	6 (0)	4 (0)
Bobcats	11 (4, 36.4%)	6 (2, 33.3%)
Other[a]	2,790 (38, 1.4%)	1,160 (15, 12.9%)
Total	3,479 (128, 3.7%)	1,379 (33, 2.4%)

[a] Other animals included: bats, bears, beaver, cats, deer, dogs, donkeys, feral hogs, ferrets, Florida panthers, gerenuk, goats, hamsters, horses, kudu, llamas, mice, opossums, otters, pigs, rabbits, rats, squirrels, wolf-dog hybrids, and zebras.

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA.

Florida WS submitted 125 enhanced surveillance brainstem samples to the CDC for rabies testing in 2007; 124 were raccoons and 1 was a feral cat from within the ORV zone that were not involved in a human or domestic animal exposure incident. Two raccoons from Pasco County tested positive for the raccoon variant of rabies.

The CDC also analyzed 193 blood serum samples for rabies VNA submitted by Florida WS in 2007. This represented a 30.1% decrease from the 276 samples submitted by WS in 2006. The Florida ORV program anticipates higher numbers of submissions to this laboratory in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2007 – EVALUATION

Florida's 2007 ORV bait distribution occurred in February and post-ORV program evaluation data (serology, tetracycline, and age results) were available at the time of this report.

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; fishmeal-coated sachet [CS] baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

Serum samples from 190 raccoons were collected from 19 March through 3 May, 4-11 weeks following the 2007 ORV bait distribution in Florida (Table 2). Of these samples, 56 (29.5%) demonstrated a positive rabies VNA response. This was up from an 11.8% positive response following the 2006 ORV bait distribution. Sera were also collected from 2 cats during post-ORV evaluation; they showed no detectable rabies antibodies. In addition, tooth samples were collected from 181 total raccoons (trapping and surveillance) for tetracycline analysis. Of these, 18.8% indicated a presence of tetracycline. This was up from 11.7% presence of biomarker following the 2006 ORV bait distribution. In 2007, only 12 raccoons exhibited both a positive rabies antibody response and the presence of tetracycline biomarker.

Table 2. Serology and tetracycline biomarker results of raccoon biological samples collected during post-ORV trapping and enhanced surveillance activities in Florida, 2007.

	Post-ORV trapping	**Enhanced surveillance**
Sample collection timeframe	19 Mar.-3 May	27 Mar.-29 Jun.
Weeks post-ORV	4-11	5-19
ORV bait type	FMP	FMP
Unique raccoons	191	124
	Serology	
Testable blood samples	190	n/a
Positive rabies antibody response (≥0.05 IU)	56 (29.5%)	
	Tetracycline biomarker	
Testable tooth samples	165	16
Presence of tetracycline biomarker	30 (18.2%)	4 (25.0%)

Age Results.--In 2007, 190 teeth were collected from raccoons during post-ORV trapping and enhanced surveillance activities; however, only 137 were able to be aged (Figure 2). Age results are typical, with the population dominated by raccoons ≤1 year old.

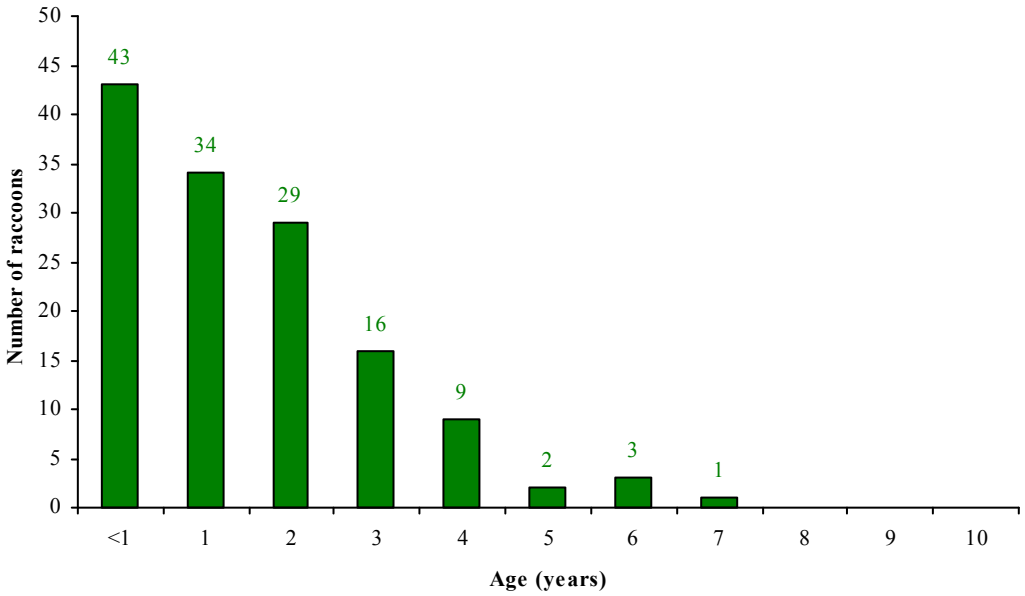

Figure 2. Age class distribution of 137 raccoon tooth samples collected during post-ORV trapping and enhanced surveillance activities in Florida, 2007.

SUMMARY

During 2007, WS completed its fifth year of cooperative participation in rabies management in Florida. The focus of activities this year was ORV bait distribution, collecting post-ORV samples, and increasing enhanced surveillance efforts in the bait zone area. Since WS' involvement in the Florida cooperative rabies management program began in 2003, over 3.0 million ORV baits have been distributed. In 2008, Florida's ORV zone will be re-designed to place more of an emphasis on protecting Pinellas County. An area of high bait density (150 baits/km^2) will be established closest to the Pinellas County border, while areas further out will remain at 75 baits/km^2. By this new design, Lake, Polk and Sumter Counties will not be included in the 2008 ORV Bait Distribution Program. Post-ORV samples will be collected by WS from within Pinellas County to determine bait efficacy. Enhanced surveillance (i.e., road-kill collection and sick/strange-acting submissions) will be increased in the coming year. The dRIT will be implemented on these enhanced surveillance samples.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
GEORGIA 2007

BACKGROUND

Raccoon (*Procyon lotor*) rabies was first documented in Florida in 1947. The disease spread northward, entering South Georgia during the 1960s. Raccoon rabies is now enzootic throughout the state. The Georgia Wildlife Services (WS) oral rabies vaccination (ORV) program began in April 2003. Initially, through the use of enhanced surveillance, Georgia's program was designed to help determine the leading edge of the raccoon rabies variant within the state. During the summer of 2003, it was determined that the distribution of ORV baits would occur in Georgia during November 2003, forming the Georgia-Alabama-Tennessee (GAT) ORV zone (Figure 1).

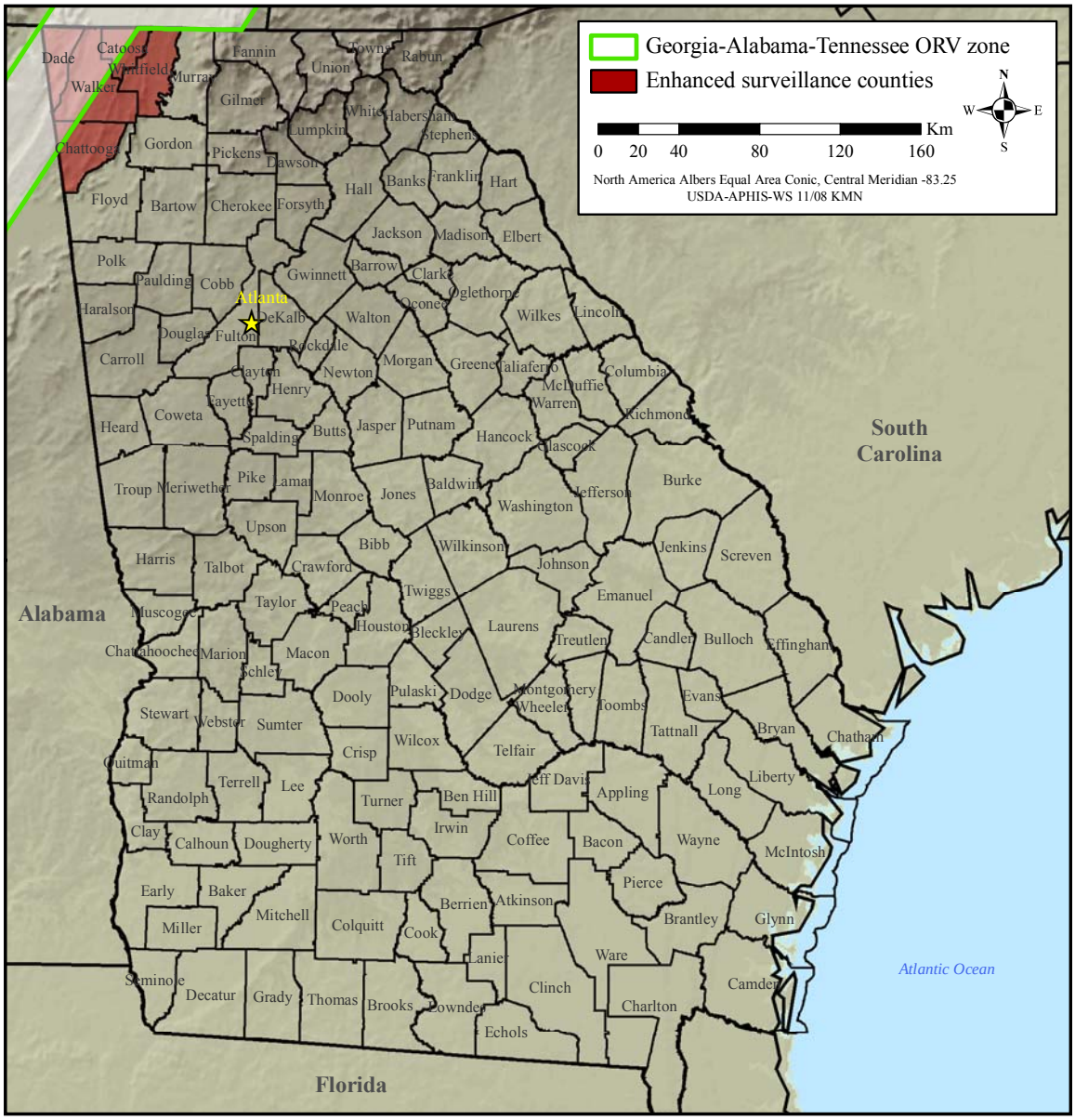

Figure 1. Wildlife Services cooperative rabies management program activities in Georgia, 2007.

Since that time, WS' major cooperators on the Georgia rabies management program have been: the Georgia Department of Human Resources Public Health Division (GDHR), the Georgia Department of Natural Resources

(GDNR), the Georgia Department of Agriculture, and the Centers for Disease Control and Prevention (CDC). In 2007, additional support on the local level was provided by Walker County Animal Control, and the City of Chickamauga Police Department. These cooperators participated in various aspects of the ORV program including providing public information, assisting with aerial and ground bait distribution, and enhancing rabies surveillance.

ORV PROGRAM 2007

Bait Distribution

For the fifth consecutive year, WS participated in bait distribution efforts in northwestern Georgia; 89,560 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 1,450.5 km^2 (560.1 mi^2). The ORV zone included portions of Catoosa, Chattooga, and Walker Counties, and all of Dade County (Figure 1). Aerial baiting was based out of Albertville, Alabama from 3-6 October, with 62,560 fishmeal polymer (FMP) baits distributed via fixed-wing aircraft provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA). From 1-6 October, 27,000 FMP baits were distributed by hand in areas too populated to bait by air. Since its program inception in 2003, WS has distributed 475,204 ORV baits in Georgia.

Enhanced Surveillance

In 2007, WS continued enhanced rabies surveillance in the northwestern part of the state by collecting 81 samples from road killed, abnormally behaving, and nuisance animals submitted by local animal control agencies in 5 counties (Figure 1). All animals were tested for rabies and included the following species: bat (*Chiroptera* spp.), domestic/feral cat (*Felis catus*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), raccoon, striped skunk (*Mephitis mephitis*), and serval (*Leptailurus serval*) (Table 1). Three of 81animals (3.7%) tested were positive for rabies. A private landowner shot the serval near his dog's pen and called WS to collect it. Wildlife Services contacted the GDNR and was given permission to sample the animal for rabies testing. The original owner of the serval was never located.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Georgia WS personnel continued to conduct dRIT testing in 2007, and tested all 81 enhanced surveillance samples for rabies using the dRIT (Table 1). Of these samples, 3 tested positive and 78 were negative. All positives and 10% of all negative samples were sent to the CDC for confirmation and variant typing. The CDC (using the dFA test) had 100% agreement with WS dRIT results on the negative samples. The 3 positives had not been confirmed or variant typed at the time of printing of this report. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Georgia.

Table 1. Animals tested for rabies by Wildlife Services using the Direct Rapid Immunohistochemistry Test (dRIT) in or adjacent to ORV counties in northwestern Georgia, 2007 (rabies positives in parentheses).

County	Bat	Cat	Gray fox	Red fox	Raccoon	Skunk	Serval	Total
Catoosa				1	3	1		5
Chattooga					4			4
Dade	1	1	2		7	1		12
Walker			5		42 (1)	7 (2)	1	55 (3)
Whitfield					3	2		5
Total	1	1	7	1	59 (1)	11 (2)	1	81 (3)

Post-ORV Monitoring

In December 2007, WS conducted post-ORV trapping in Catoosa and Walker Counties. Cage traps were used over 626 trap nights to capture 135 unique raccoons and collect blood serum samples from all of them and a tooth sample from 92 of them. All 135 raccoons were immobilized, processed and released. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 34 opossums (*Didelphis virginiana*), 24 domestic/feral cats, and 2 striped skunks.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Georgia cooperates with the GDHR Public Health Laboratory (PHL) and the CDC.

Georgia Department of Human Resources Public Health Laboratory.--The PHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). In 2007, the PHL tested 2,235 animal submissions and confirmed 301 cases of rabies statewide: 193 raccoons, 35 skunks, 18 bats, 18 foxes, 16 cats, 10 dogs, 3 bobcats (*Lynx rufus*), 2 cattle (*Bos taurus*), 2 horses (*Equus caballus*), 1 coyote (*Canis latrans*), 1 otter (*Lutra canadensis*), 1 sheep (*Ovis aries*), and 1 groundhog (*Marmota monax*). Raccoons accounted for 64.1% of the cases statewide. There were 32 animals submitted from the 4 ORV counties and 3 of those were positive for rabies (Table 2). The 3 positives within the bait zone were located on the eastern edge of the zone. For more information on historical animal rabies cases in Georgia please visit: http://health.state.ga.us/epi/disease/rabies.asp

Table 2. Submissions to the Georgia Department of Human Resources Public Health Laboratory for rabies testing from counties treated with oral rabies vaccine in Georgia, 2007.

County	Submissions	Rabies Positive
Catoosa	14	2 (horses) 14.3%
Chattooga	5	0
Dade	3	0
Walker	10	1 (skunk) 10.0%
Total	32	3 (2 horses, 1 skunk) 9.4%

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). As per protocol, WS sends all positives, indeterminates and 10% of the negatives found using the dRIT to the CDC for confirmation and variant typing. The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA).

In 2007, Georgia WS submitted 8 negative and 3 positive wildlife brainstem samples to the CDC for confirmation and validation of the dRIT results and variant typing. Georgia WS also submitted 135 blood serum samples for rabies VNA analysis to the CDC in 2007. This represented a 10.2% increase from the 123 samples submitted by WS in 2006. The Georgia ORV program anticipates similar numbers of brainstem and serum sample submissions to the CDC in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2005-2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the

current year's (2007) evaluation data were available so they have been included here instead (2006 serology and biomarker results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

Serum samples from 135 raccoons were collected 9 weeks following the 2007 ORV bait distribution in Georgia. The serology results were not available at the time of printing. In addition, 92 tooth samples were collected from raccoons and submitted to Matson's Laboratory LLC (Milltown, Montana, USA) for tetracycline biomarker analysis and aging. Biomarker analysis indicated that 26 (28.3%) of the teeth showed presence of tetracycline. This is consistent with the previous 2 years: 23.5% in 2006 and 22.6% in 2005.

Age Results.--Age results were not available at the time of printing of the 2006 annual report; they are included below with 2007 results. From 2005 through 2007, 276 raccoon teeth were aged using premolars of live-captured, found dead, or euthanized animals collected during trapping and enhanced surveillance activities (Figure 2). Age results are typical, with the populations dominated by animals ≤2 years old. One raccoon in 2007 was aged at 13 years old.

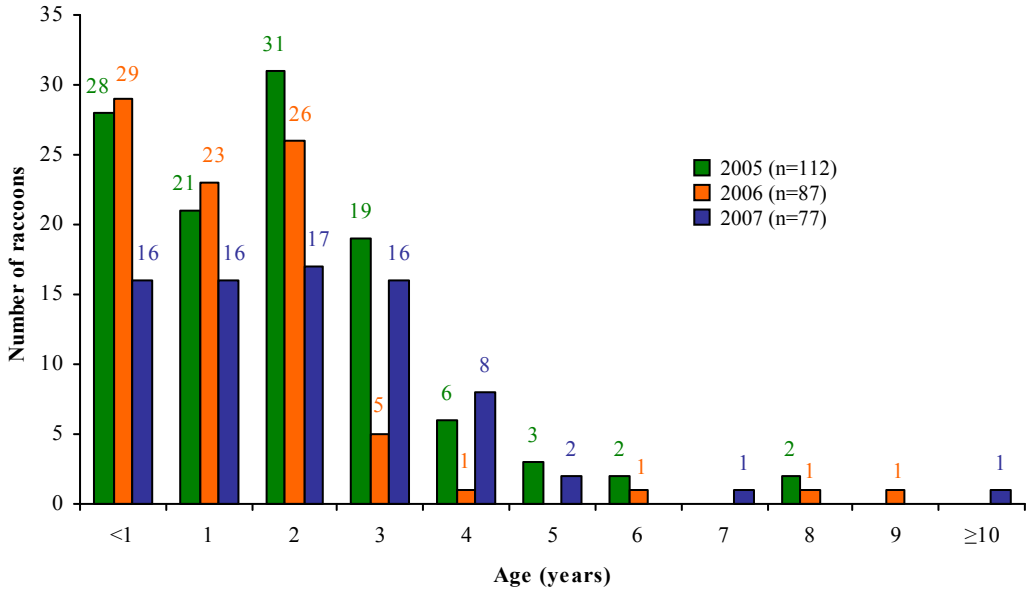

Figure 2. Age class distribution of 276 raccoon tooth samples collected by Wildlife Services during the cooperative rabies management program in Georgia, 2005-2007.

SUMMARY

During 2007, WS completed its fifth year of cooperative participation in rabies management in Georgia. Work emphasized ORV bait distribution, enhanced surveillance of raccoon rabies, and post-ORV monitoring and evaluation in northwestern Georgia. Since WS' involvement in the Georgia cooperative rabies management program began in 2003, over 475,000 ORV baits have been distributed and the program has continued to receive positive support from both cooperators and the general public. Future ORV baiting strategies in Georgia will continue to be directed towards halting the spread of raccoon rabies into the western U.S.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
KANSAS 2007

BACKGROUND

Kansas has one terrestrial variant of the rabies virus in striped skunks (*Mephitis mephitis*) and another variant in bats (*Chiroptera* spp.). The South Central skunk variant is enzootic over nearly all of the state. In 2007, Kansas confirmed 110 cases of rabies in the state; striped skunks accounted for 73 (66.4%) of those cases. A 32.5% increase from the 83 statewide cases reported in 2006 emphasizes the need for more information on rabies epidemiology in Kansas. In 2003, the Kansas Wildlife Services (WS) program, Kansas State University College of Veterinary Medicine (KSUCVM) Rabies Lab and the Fort Riley Military Installation (FRMI) began a cooperative effort to collect information on the striped skunk population found on the FRMI in northeast Kansas (Figure 1).

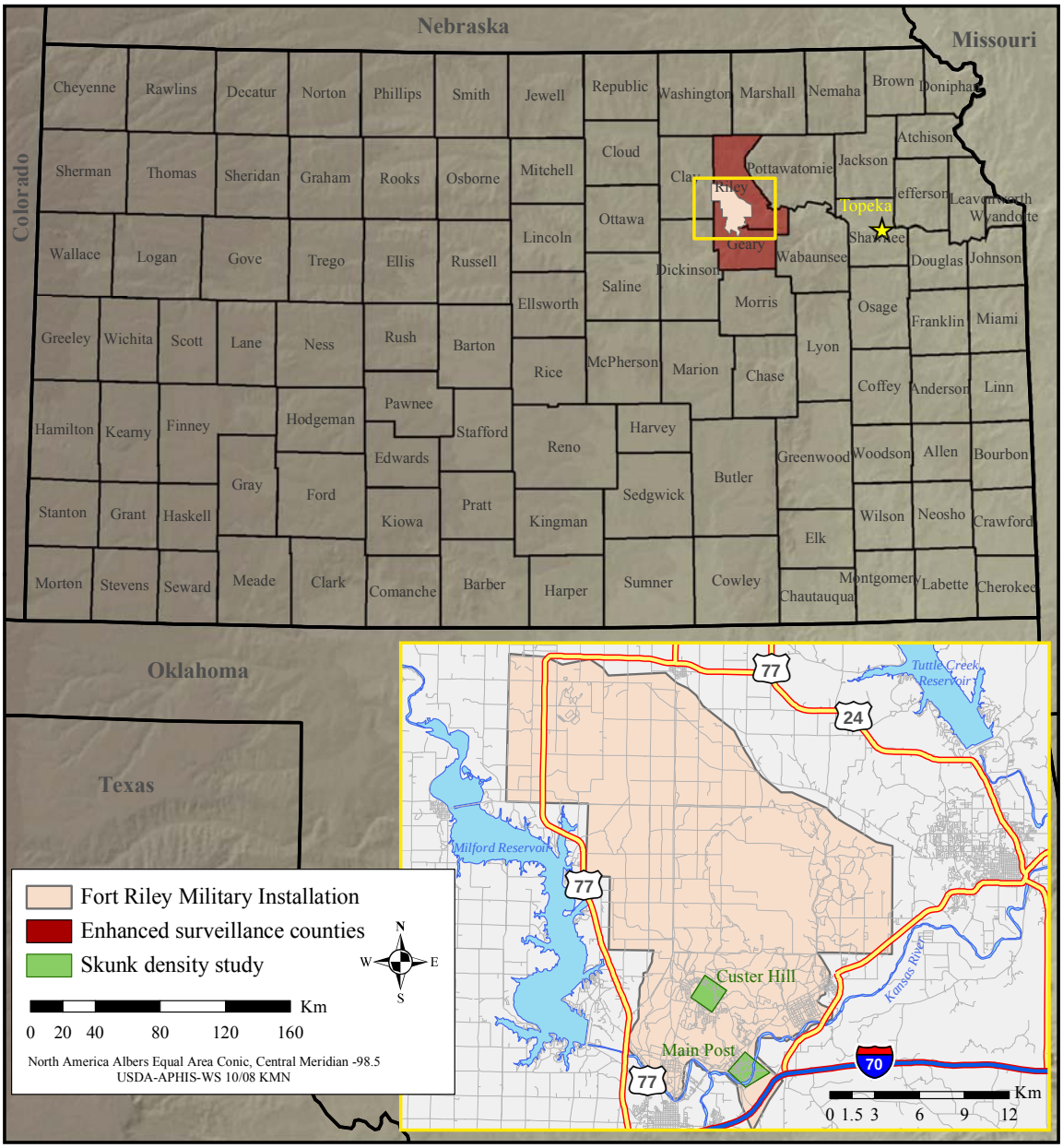

Figure 1. Wildlife Services cooperative rabies management program activities in Kansas, 2007.

Wildlife Services has historically had a full-time wildlife biologist stationed at the FRMI who regularly removed several skunks each year while responding to routine nuisance animal complaints on the installation. Due to WS' existing presence at the Fort, and the nature of the land available to sample both urban and rural animal populations, the FRMI is an ideal location to monitor rabies and conduct skunk population density studies.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

There is currently no oral rabies vaccination (ORV) bait distribution program in Kansas.

Enhanced Surveillance

As nationwide research continues to find a more effective oral rabies vaccine for use in skunks, the Kansas WS program has focused much of its efforts on enhancing rabies surveillance to better define the distribution and prevalence of the virus on the FRMI. With a population of anywhere between 45,000-55,000 soldiers, families and civilians, the FRMI is considered the ninth largest "city" in the state. Citizens of Fort Riley report all nuisance animal problems including sick or strange acting animals to either the Military Police or a Public Works service hotline. These reports are then funneled to the WS biologist stationed there. This arrangement allows for excellent indirect rabies surveillance. Due to the unique situation at the FRMI described above, and a reporting system already in place, the WS biologist potentially has access to most diseased animals. Over the last several years, WS has collected 1-3 rabid striped skunks annually.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, WS is not planning training or implementation of the dRIT because the KSUCVM is meeting enhanced surveillance testing needs.

Population Monitoring

Wildlife Services has conducted several striped skunk density studies in Kansas by modifying the National Rabies Management Program (NRMP) protocol for raccoon density studies. Each study has consisted of 50 cage traps set over a target study area of 3 km^2 (1.2 mi^2) and baited with dry cat food. Traps were not relocated during the 10-day studies (the raccoon protocol calls for traps to be relocated every 2-3 days if they have not captured a unique raccoon).

During 2003-2006, WS conducted 8 skunk density studies (3 in the rural training areas of Fort Riley and 5 in a heavily populated urban area on the FRMI). Indices to skunk density across the 8 studies were similar regardless of habitat type (approximately 2-3 skunks/km^2).

In 2007, WS conducted 2 skunk density studies on sites with similar suburban habitats, the first of which was located on Custer Hill (Figure 1). While only 2 unique skunks were captured in the first study, 32 raccoons (*Procyon lotor*), 12 opossums (*Didelphis virginiana*), and 2 feral cats (*Felis catus*) were also captured during the study (Table 1). The second study was conducted on historic Main Post of FRMI (Figure 1). During this study, 18 skunks were captured, along with 27 raccoons, 23 opossums, and 5 feral cats (Table 1). All skunks, raccoons, and opossums were euthanized in 2007 at the request of the FRMI. Feral cats were taken to the installation's veterinary services to scan for identification chips. None were found and they were euthanized at the request of the FRMI.

All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations. The number of raccoon captures has been consistently high, relative to skunk captures, since studies began in 2003 (208 raccoons vs. 76 skunks). This could be due in part to the NRMP

density study protocol, which was originally designed for raccoons. As skunk research and density studies continue, there may be a need for a dedicated skunk density protocol.

Table 1. Index to skunk density studies on the Fort Riley Military Installation, Riley County, Kansas, 2007.

	Study #1 (Custer Hill)	Study #2 (Main Post)
Time of study	4-14 June	13-23 August
Macrohabitat	Suburban	Suburban
Target trap nights	500	500
Unique skunks	2	18
Trap success of skunks[a]	0.4%	3.6%
Non-target captures	14	28
Area (km^2)	3.0	3.0
Skunk density index[b]	0.67	6.0

[a] Unique skunks/trap nights x 100.
[b] Unique skunks/km^2.

Other Rabies Management Program Activities

There are hundreds of buildings on the FRMI that both humans and resident big brown bats (*Eptesicus fuscus*) occupy. Historically, nuisance bats were excluded and/or relocated from buildings and only bats involved in a human exposure were euthanized for rabies testing. In 2004, in cooperation with a DOD biologist, WS initiated a basic monitoring program to determine the prevalence of rabies in the local bat population on the FRMI. In 2005, WS continued to remove a select few bats from various buildings and euthanize them for rabies testing; there were no positives. Due to the overwhelming number of negatives WS discontinued rabies testing of bats during 2006.

Non-target Captures

Non-target animals captured and euthanized by WS in 2007 included: 59 raccoons, 35 opossums, and 7 feral cats. All animals were euthanized at the request of the DOD for nuisance complaint reasons on the FRMI.

Rabies Laboratory Cooperation

The KSUCVM operates the state's public health rabies surveillance laboratory. They test animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by the public) and enhanced surveillance (specimens not involved in an exposure and often submitted by WS).

The KSUCVM Rabies Lab tested 1,302 animals for rabies in 2007 from Kansas (Table 2); the Lab serves as the rabies testing facility for Nebraska as well. The number of samples tested in 2007 represented a 7.6% increase from the number of samples tested in Kansas in 2006. Positive animals were submitted from 45 of 105 (42.8%) counties throughout the state, Geary and Riley Counties (where the FRMI is located) had no positives in 2007.

Skunks, raccoons, coyotes (*Canis latrans*), foxes (*Canidae* spp.), and bobcats (*Lynx rufus*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance in support of ORV. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 86.3% of the animals tested for rabies in Kansas in 2007 are reported by WS as "other." For a full listing of animals tested from Kansas in 2007 by the KSUCVM Rabies Lab please visit: www.vet.ksu.edu/depts/rabies/kansas.htm

Table 2. Animals tested for rabies by the Kansas State University College of Veterinary Medicine Rabies Lab in Kansas, 2007 (percent rabies positive in parentheses).

	Rabies Negative	Rabies Positive	Total Tested
Skunks	32	73	105 (69.5%)
Raccoons	65	0	65 (0%)
Coyotes	5	0	5 (0%)
Foxes	3	0	3 (0%)
Bobcats	1	0	1 (0%)
Other[a]	1,086	37	1,123 (3.3%)
Total	1,192	110	1,302 (8.4%)

[a] Other animals included: bat, beaver, camel, cat, chipmunk, cow, deer, dog, goat, gopher, guinea pig, horse, kangaroo, llama, mole, mouse, muskrat, opossum, rabbit, rat, rodents, sheep, shrew, squirrel, and woodchuck.

SUMMARY

During 2007, WS completed its fifth year of cooperative participation in rabies management in Kansas, and specifically on the FRMI. Wildlife Services completed 2 more skunk density studies, totaling 10 studies since 2003, and Kansas remains the only program in the nation specifically targeting skunk populations for density indexing. These valuable data can be used to determine ORV baiting strategies should an effective vaccine/bait delivery system become available for targeting skunks. Wildlife Services will continue to enhance rabies surveillance in skunks in 2008 with the support of cooperators at Fort Riley and the KSUCVM.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
KENTUCKY 2007

BACKGROUND

Kentucky has 1 terrestrial variant of the rabies virus in striped skunks (*Mephitis mephitis*) and another variant in bats (*Chiroptera* spp.). The North Central skunk variant is enzootic over most of the state. In 2002, Wildlife Services (WS) began participating in a cooperative rabies management program in Kentucky as an integral part of the National Rabies Management Program to stop the westward spread of the raccoon (*Procyon lotor*) variant of the rabies virus. In an effort to obtain baseline information on raccoon populations in Kentucky and actively search for raccoon rabies west of the Appalachian Ridge (AR) oral rabies vaccination (ORV) zone, WS began conducting raccoon density studies and enhancing rabies surveillance in the eastern counties bordering Ohio, Virginia, and West Virginia. Since 2002, WS has continued to collect road killed, sick acting, and animals trapped for fur to enhance rabies surveillance in eastern Kentucky (Figure 1). To date, no positive cases of raccoon rabies have been documented in the state.

Activities conducted by WS are in cooperation with the Kentucky Department of Fish and Wildlife Resources (KDFWR), the Kentucky Department for Public Health (KDPH), and the Centers for Disease Control and Prevention (CDC).

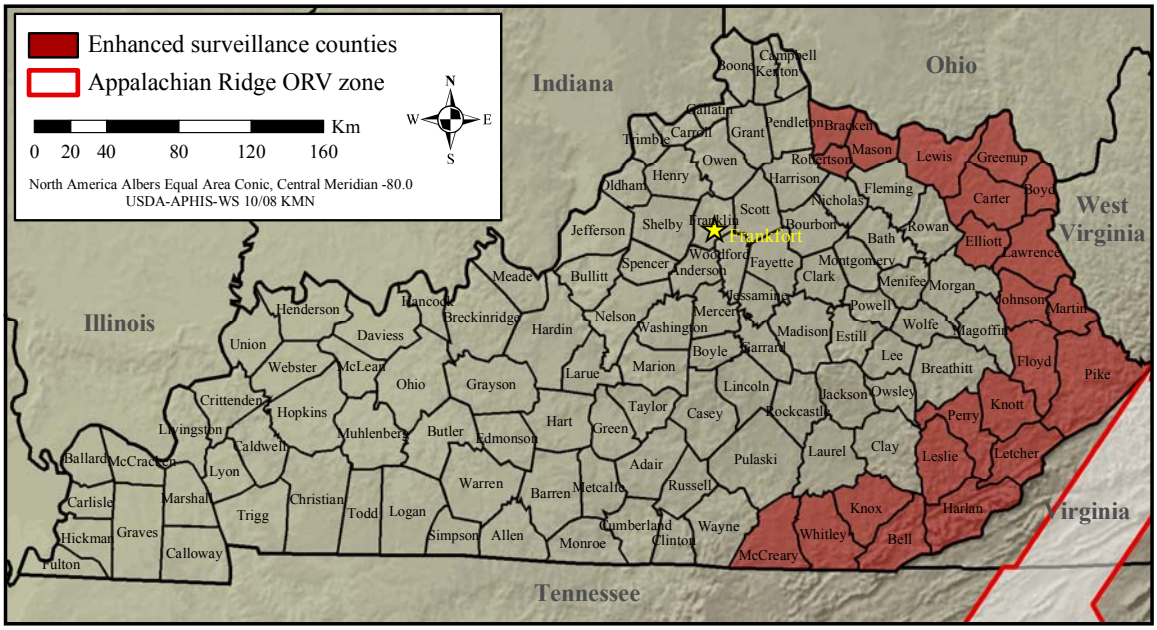

Figure 1. Wildlife Services cooperative rabies management program activities in Kentucky, 2007.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

There is currently no ORV bait distribution program in Kentucky.

Enhanced surveillance

In 2007, WS conducted enhanced surveillance for the detection of raccoon rabies in 22 counties in eastern Kentucky (Figure 1). This created a surveillance corridor along the borders with Ohio, West Virginia, Virginia, and Tennessee. In addition to cooperating with the KDFWR, WS personnel recruited state and local agencies to collect suspect animals for testing. An emphasis was placed on raccoons, striped skunks, gray foxes (*Urocyon cinereoargenteus*), red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*) and bobcats (*Lynx rufus*) that exhibited strange behavior, were found dead in unusual places, or were fresh road killed animals. Nuisance and fur-trapped animals were also collected. Wildlife Services purchased small chest freezers and strategically located them within

14 of these counties for cooperators to store suspect animals for testing. These efforts resulted in the collection and testing of 132 animals: 67 raccoons, 34 coyotes, 11 red foxes, 11 gray foxes, 5 bobcats, and 4 striped skunks. All samples tested negative for the rabies virus.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and to avoid overburdening of rabies laboratories. However, it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

A Biosafety 2 (BSL-2) laboratory at the Louisville Metro Department of Health and Wellness was secured and fitted to conduct the dRIT tests in Kentucky in 2006. During 2007, WS tested all 132 animals collected through enhanced surveillance efforts using the dRIT; they all tested negative. Ten percent of the negatives were sent to the CDC for confirmation. Using the dFA test, the CDC had 100% agreement with the WS dRIT results. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Kentucky.

Rabies Laboratory Cooperation

Wildlife Services' rabies surveillance program in Kentucky cooperates with the KDPH, Division of Laboratory Services (DLS) in Frankfort, the Breathitt Veterinary Center (BVC) at Murray State University in Hopkinsville, and the CDC.

Kentucky Department for Public Health, Division of Laboratory Services and the Breathitt Veterinary Center.--Both the DLS and the BVC are responsible for testing animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure). Positive samples from both labs are then sent to the CDC for rabies variant typing.

The DLS and BVC tested 1,079 animal brainstem samples for rabies in 2007 (Table 1). This represents a 4.2% decrease from the number of samples tested in 2006. The 2007 samples were submitted from 112 of 120 counties in Kentucky and from 18 counties within the designated enhanced rabies surveillance zone. Statewide, the labs confirmed 20 cases of rabies: 6 bats, 5 dogs (*Canis lupus familiaris*), 4 skunks, 3 horses (*Equus caballus*), and 2 cats (*Felis catus*).

Raccoons, skunks, foxes, coyotes, and bobcats are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 86.4% of the animals tested for rabies in Kentucky in 2007 are reported by WS as "other." For more information on rabid animals by county in 2007 please visit: http://chfs.ky.gov/dph/epi/rabies.htm

Table 1. Animals tested for rabies by the Kentucky Department for Public Health, Division of Laboratory Services and the Breathitt Veterinary Center at Murray State University in Kentucky, 2007 (percent of animals tested from enhanced surveillance zone in parentheses).

	Statewide	Within Wildlife Services' enhanced rabies surveillance zone
Raccoons	91	2 (2.2%)
Skunks	21	0
Foxes	19	2 (10.5%)
Coyote	16	0
Other[a]	932	55 (5.9%)
Total	1,079	59 (5.5%)

[a] Other animals included: alpaca, bats, beaver, cats, cattle, chipmunks, deer, dogs, ferret, goats, groundhogs, hamsters, horses, mink, moles, mice, muskrats, opossums, rabbits, rats, squirrels, and a wolf.

Centers for Disease Control and Prevention.--The Kentucky rabies surveillance program submitted 13 brainstem samples to the CDC in 2007 for dRIT confirmation. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

SUMMARY

During 2007, WS completed its sixth year of participation in cooperative rabies management efforts in Kentucky. The focus of activities continued to be collection of road killed or suspect rabid animals to enhance rabies surveillance west of the existing AR ORV zone (Figure 1).

In 2008, WS will increase enhanced surveillance for the raccoon variant of rabies in eastern Kentucky by continuing to recruit state and local entities to collect unusual acting and road killed animals. Surveillance efforts will be expanded to include 3 additional counties in Eastern Kentucky which will increase the enhanced surveillance activities to 25 counties bordering Ohio, West Virginia, Virginia, and Tennessee. Additionally in 2008, 2 density studies will be conducted to gather baseline information on raccoon populations in Eastern Kentucky.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
LOUISIANA 2007

BACKGROUND

To date, there have been no reported cases of the raccoon (*Procyon lotor*) variant of rabies in Louisiana, although other variants including bat (*Chiroptera* spp.) and striped skunk (*Mephitis mephitis*) do occur. In an effort to detect possible entry of raccoon rabies into the state, Wildlife Services (WS) conducted surveillance of road killed and trapped animals in Washington and St. Tammany Parishes during June, July, and August of 2007 (Figure 1).

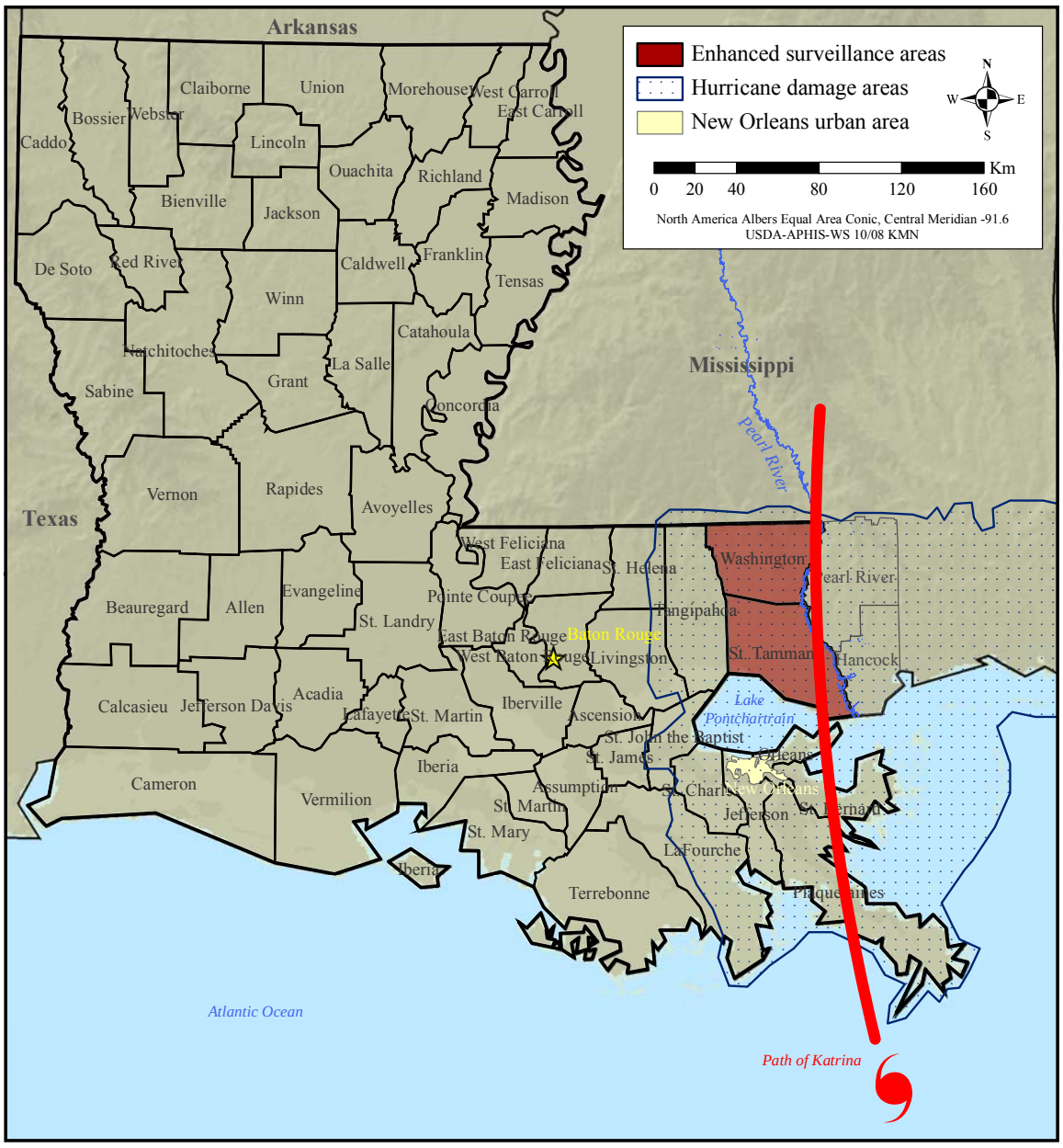

Figure 1. Wildlife Services cooperative rabies management program activities in Louisiana (2007) and lingering effects from Hurricane Katrina (2005) that may be affecting raccoon populations.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

There is currently no oral rabies vaccination (ORV) bait distribution program in Louisiana.

Enhanced Surveillance

From June-August 2007, a WS specialist completed road and highway surveys in Washington and St. Tammany Parishes to collect road killed raccoons and other small carnivores for enhanced rabies surveillance. During those months, no road kills were collected despite hundreds of miles being driven. Very few road killed raccoons were observed and none were processed due to advanced deterioration or excessive damage. In addition to these surveys WS also actively trapped both parishes in an effort to collect samples. Only 2 raccoons were caught in Washington Parish and none in St. Tammany. The impacts of hurricane damage to wildlife has been well documented in recent years (Meyers, et al. 2006; Sheikh 2005; United States Fish and Wildlife Service 2005; United States Geological Survey 2006) and the lingering effects of Hurricane Katrina on the southeastern part of Louisiana is believed to be the primary cause of so few animals being available for collection. A possible canine distemper outbreak in the local raccoon population may also be affecting the number of animals. Enhanced surveillance was suspended during August due to an almost complete lack of raccoon sign and virtually no success trapping.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

One Louisiana WS employee attended dRIT training in May 2005 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia and implemented the test in November 2005. During 2007, WS was only able to collect 2 raccoon samples for rabies testing; both tested negative using the dRIT. No samples were sent to the CDC. Louisiana WS will continue to use the dRIT in 2008 and any positives, 10% of all negatives, and all indeterminate samples will be sent to the CDC for confirmation and strain typing. Additionally, Louisiana WS plans to have 2 more personnel trained in dRIT procedures.

Rabies Laboratory Cooperation

Louisiana regulations require that testing for rabies be conducted when human exposures are involved. Testing for other exposures is not mandatory. The Louisiana Department of Health and Hospitals (LDHH) is responsible for carrying out mandates related to required rabies testing. The LDHH and WS have expressed interest in continued and expanded cooperation on rabies issues; however, the agencies do not jointly conduct any rabies projects at this time.

During 2007, the LDHH tested 751 animals for rabies (Table 1) with 6 being confirmed rabid (all from outside of WS' enhanced rabies surveillance zone): 3 bats, 1 skunk, 1 dog (*Canis lupus familiaris*), and 1 horse (*Equus caballus*). These rabid animals did not have the raccoon variant of the rabies virus.

Raccoons, skunks, foxes (*Canidae* spp.), and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 94.3% of the animals tested for rabies in Louisiana in 2007 are reported by WS as "other." For more information on rabies in Louisiana please visit: http://www.dhh.louisiana.gov and search on "rabies."

Table 1. Animals tested for rabies by the Louisiana Department of Health and Hospitals for public health surveillance in Louisiana, 2007 (percent of animals tested from enhanced surveillance zone in parentheses).

	Statewide	Within Wildlife Services' enhanced rabies surveillance zone[a]
Raccoons	37	5 (0.1%)
Skunks	6	0
Foxes	0	0
Coyotes	0	0
Other[b]	708	51 (7.2%)
Total	751	56 (7.5%)

[a] St. Tammany and Washington Parishes.
[b] Other animals included: bats, cats, cattle, dogs, goats, horses, mice, mules, opossums, rats, other rodents, squirrels, and swine.

SUMMARY

In 2007, WS completed its fifth year of participation in cooperative rabies management efforts in Louisiana by continuing enhanced rabies surveillance work in 2 gulf coast parishes. Due to lasting hurricane damage (Figure 1), the presence of target species in the surveillance zone is negligible, but a rabies specialist, using the dRIT, did manage to test 2 usable samples from the zone. Surveillance was not conducted in Pearl River and Hancock Counties in Mississippi due to ongoing hurricane recovery as well.

In 2008, WS plans to: continue enhancing rabies surveillance by conducting road and highway surveys in St. Tammany and Washington Parishes, as well as Pearl River and Hancock Counties in Mississippi; intensify trapping/reconnaissance efforts to locate and sample possible concentrations of raccoons; and train 2 more individuals in the dRIT procedures. These planned activities should aid in the effort to detect possible entry of the raccoon variant of rabies into Louisiana and southwestern Mississippi.

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WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
MAINE 2007

BACKGROUND

The raccoon (*Procyon lotor*) variant of the rabies virus was first confirmed in a striped skunk (*Mephitis mephitis*) in 1994 (York County) and has been enzootic in wildlife populations in Maine since 1995, with raccoons accounting for about half of all annual cases (Figure 1). Since 1995, the disease has progressed steadily from southern Maine to central Maine and continues to slowly progress north. During 2007 there were 86 cases of rabies confirmed in Maine including a raccoon and a skunk in Aroostook County near the township of Sherman Mills (Figure 2). These cases are in northern Maine and approximately 112 km (70 mi) north of the nearest documented case.

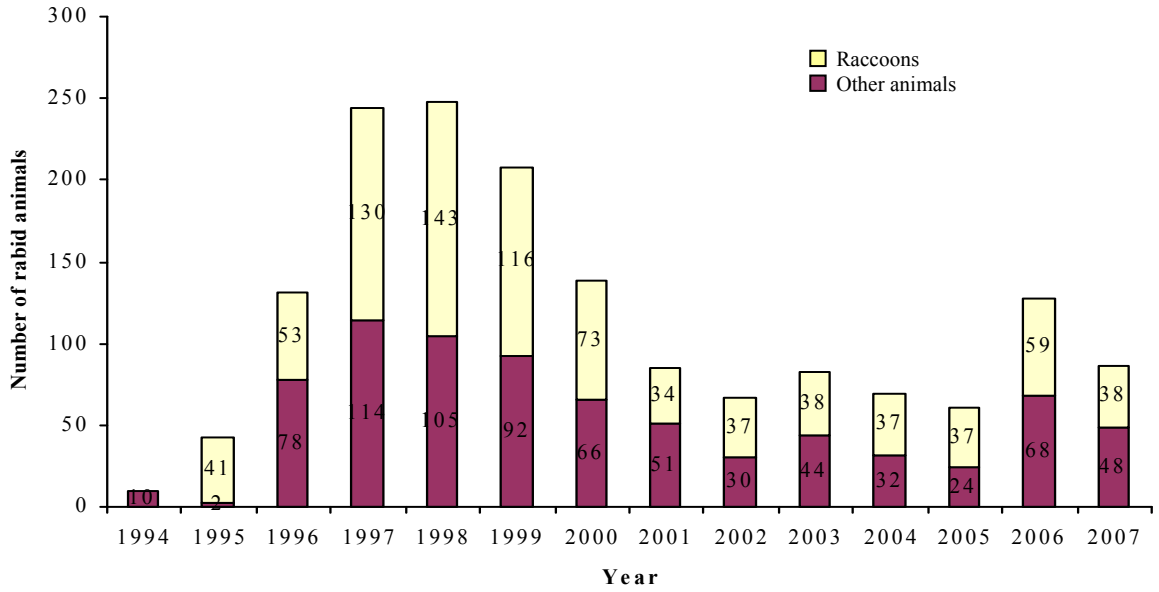

Figure 1. Confirmed rabies cases in Maine, 1994-2007.

In an effort to reduce the occurrence of rabies in Maine, the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) initiated rabies management efforts during 2003 in collaboration with New Brunswick, Canada to vaccinate raccoons and skunks. As rabies has progressed north and eastward, rabies vaccination efforts have been targeted along the Maine, USA and New Brunswick, Canada border creating a "barrier" to protect raccoon populations against rabies (Figure 2). Through vaccination efforts New Brunswick has maintained a terrestrial rabies-free status since 2002 and continued rabies surveillance and trap-vaccinate-release (TVR) rabies management efforts throughout 2007. Maine WS continues to support the international eradication of rabies through enhanced surveillance along the front line of documented cases and oral rabies vaccination (ORV) bait distribution along the international border.

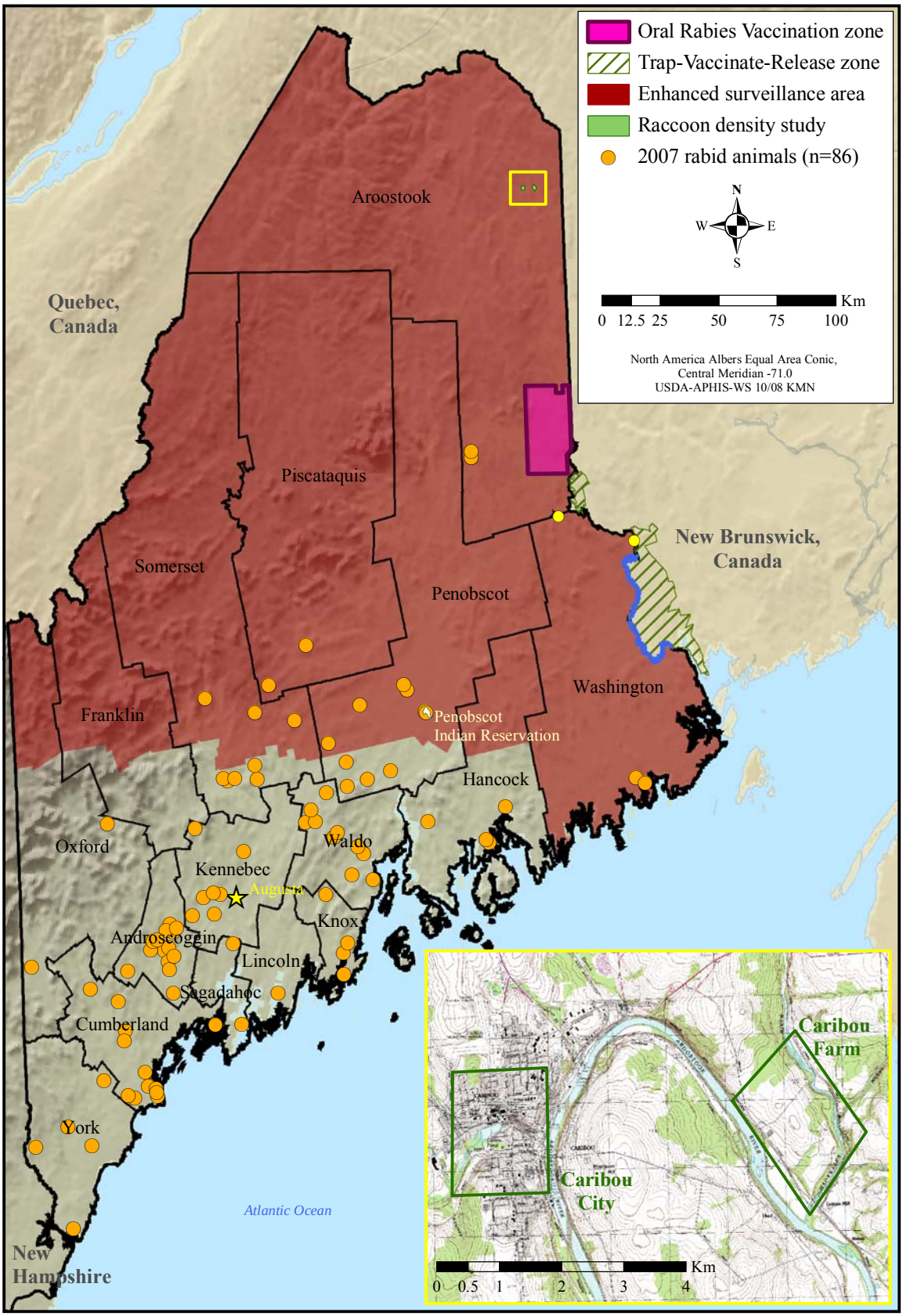

Figure 2. Wildlife Services cooperative rabies management program activities in Maine, 2007.

ORV PROGRAM 2007

Bait Distribution

Maine WS participated in ORV baiting activities for the fifth consecutive year in 2007 by distributing 50,000 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) over 702.1 km^2 (271.1 mi^2) of northeastern Maine (Figure 2). On 7 August, baiting activities were based out of the Houlton International Airport in Houlton, Maine and 47,492 fishmeal polymer (FMP) baits were distributed by air, while 2,508 FMP baits were distributed by hand within the Houlton city limits and along the Route 1 arterial highway. Fixed-wing aircraft were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS provided ground support and served as navigators and flight crew in the planes. Since its program inception in 2003, WS has distributed 519,017 ORV baits in Maine.

The 2007 ORV zone located within Aroostook County averaged 16 km (10 mi) wide and 40 km (25 mi) long along the Maine-New Brunswick border. Maine's ORV zone is a northern continuation of New Brunswick's TVR zone. Together, the international effort to help stop the northward and eastward spread of rabies spans approximately 160 km (100 mi) of the U.S.-Canada border. Raccoon rabies was first confirmed in neighboring New Brunswick in 2001, but since March 2002 New Brunswick has maintained a "rabies-free" status due to the implementation of a large-scale TVR program. To date, this program has resulted in more than 5,000 raccoons and striped skunks being trapped, vaccinated, and released in New Brunswick. The documented movement of rabies provides Maine an important role in helping to prevent the re-introduction of raccoon rabies into New Brunswick, Canada.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turn around and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

In 2007, Maine WS continued to conduct enhanced rabies surveillance throughout northern Maine and along the Canadian border in areas where raccoon rabies was emerging or had not yet been documented. Surveillance methods included road kill surveys and the collection of sick or suspicious acting animals that had no contact with humans or domestic animals. Wildlife Services also assisted a Penobscot Nation biologist with procedures on specimen collection, safe handling, and storage of rabies suspect samples to be tested by WS using the dRIT. Enhanced surveillance efforts on the Penobscot Indian Reservation (Figure 2) allow the tribe to monitor rabies prevalence on Indian Island which is located in the Penobscot River, the northern extension of where rabies is documented in Maine.

During 2007, WS provided logistics and funding to collect 130 animals for rabies testing. Twenty-four samples were unsuitable for testing, but 106 animals were tested for rabies: 10 by the Maine Department of Health and Human Services, Health and Environmental Testing Laboratory (MDH HETL) and 96 by WS using the dRIT. The testable animals included 69 raccoons, 30 skunks, 4 red foxes (*Vulpes vulpes*), 1 bobcat (*Lynx rufus*), 1 domestic goat (*Capra aegagrus hircus*), and 1 porcupine (*Erethizon dorsatum*). The MDH HETL confirmed 2 positives (1 raccoon and 1 skunk), while WS also confirmed 2 positives (both raccoons from the Penobscot Nation). Wildlife Services' positive dRIT samples and 10% of all negatives were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Maine.

Population Monitoring

From 2002 to 2006, WS conducted 12 raccoon density studies in northeastern Maine using National Rabies Management Program (NRMP) protocols. The standard protocol (50 cage traps set on a target study area of 3 km^2 [1.2 km^2] for 10 consecutive nights) was used during 10 of those studies and yielded an average index to raccoon density of 3.8 raccoons/km^2. The NRMP low density protocol (which involves 5 consecutive nights of trapping

instead of 10) was established in 2005 to eliminate futile effort in areas where raccoon densities are believed to be ≤ 1 raccoon/km^2. This protocol was used during 2 of the studies which averaged 0.5 raccoons/km^2.

In 2007, WS conducted 2 more raccoon density studies, one in agricultural habitat in Caribou Township and one in an urban setting within the Caribou City limits (Figure 2 inset). Both studies were conducted approximately 80 km (50 mi) north of the current bait zone in an ORV naïve area (not previously treated with ORV). The indexes to density were approximately 7 raccoons/km^2 and 18 raccoons/km^2 respectively (Table 1). During the 2 studies, 74 raccoons and 16 skunks were trapped, processed, and released. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 1. Index to raccoon densities in Caribou, Maine, 2007.

	Caribou Farm	**Caribou City**
Time of study	21 June-1 July	10-20 July
Macrohabitat	Agriculture	Urban/suburban
Target trap nights	500	500
Unique raccoons	20	54
Recaptured raccoons	9	18
Non-target captures[b]	7	9
Area (km^2)	3.13	3.05
Raccoon density index[a]	6.4	17.7

[a] Unique raccoons/km^2.
[b] Non-target captures include skunks.

Post-ORV Monitoring

From 4-21 September, WS conducted post-ORV trapping in Aroostook County. Cage traps were used over 1,000 trap nights to capture 126 unique raccoons and 11 unique skunks. One raccoon was euthanized due to sunken eyes and aggressive behavior; it tested negative for rabies using the dRIT. The remaining 125 raccoons were released and tooth and blood serum samples were collected from most of them. All of the skunks were released with sera being collected from 7 of them. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 24 red squirrels (*Tamiasciurus hudsonicus*), 23 snowshoe hares (*Lepus americanus*), 13 woodchucks (*Marmota monax*), 11 domestic/feral cats (*Felis catus*), 3 porcupines (*Erethizon dorsatum*), 2 muskrats (*Ondatra zibethicus*), 1 black bear cub (*Ursus americanus*), 1 northern flying squirrel (*Glaucomys sabrinus*), and 1 weasel (*Mustela erminea*). In addition, 1 red squirrel was found dead in a cage trap and 1 snowshoe hare was euthanized dues to severe leg injuries.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Maine cooperates with the MDH HETL and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC).

Maine Department of Health and Human Services, Health and Environmental Testing Laboratory.--The HETL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure) at no cost to the public. The HETL has provided in-kind services to test enhanced rabies surveillance samples (specimens not involved in an exposure and submitted by WS) over the last 6 years. The lab is available 24 hours a day for specimen drop off and results are routinely available the same day the test is conducted. The HETL tested 738 animals statewide in 2007 and confirmed 86 cases of rabies in Maine (Table 2).

Raccoons, skunks, foxes, and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why

78.0% of the animals tested for rabies in Maine in 2007 are reported by WS as "other." For more information on current and historical animal rabies cases in Maine (by year, county, town, and species) please visit: http://www.maine.gov/dhhs/etl/rabies/rabies.htm

Table 2. Animals tested for rabies by the Maine Department of Health and Human Services, Health and Environmental Testing Laboratory, 2007.

	Number tested	Number rabies positive
Raccoons	76	38 (50.0%)
Skunks	66	31 (47.0%)
Foxes	18	4 (22.2%)
Coyotes	2	0
Other[a]	576	13 (2.6%)
Total	738	86 (11.7%)

[a] Other animals included: bats; beaver; bobcat; chipmunk; deer; ermine; fisher; mink; mole; mouse; muskrat; opossum; otter; porcupine; rabbit; rat; squirrel; weasel; woodchuck; and domestic alpaca, cats, cows, dogs, donkey, ferret, goat, hamster, horse, lamb, llama, pig, rabbit, sheep, and wolf hybrid.

New York State Department of Health's Rabies Laboratory at the Wadsworth Center.--The WC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). In 2007, Maine WS submitted 217 blood serum samples (198 raccoons and 19 skunks) for rabies VNA analysis to the WC. This was up 61.9% from the number of samples submitted in 2006. Maine WS anticipates 100-200 samples being submitted in 2008.

The timeliness of test results from both laboratories enhances rabies management planning and program analysis concurrent with real-time program implementation. Wildlife Services has had an efficient and cooperative relationship with both laboratories since 2003, and they remain critical to the surveillance and monitoring phases of the ORV program in Maine.

ORV PROGRAM 2007 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and teeth are analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, WS live-trapped 224 unique raccoons; 126 were trapped 4-7 weeks post-2007 ORV bait distribution, 1 was from an area that was last baited in 2003 (no blood or teeth taken), and 97 were trapped in an ORV naïve area (Table 3). Blood and tooth samples were collected from most of these animals and serum samples were sent to the WC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Tooth results were pending from Matson's at the time of this report.

Twenty-eight skunks were also trapped in 2007; 11 were trapped 4-7 weeks post-2007 ORV bait distribution and 17 were trapped in an ORV naïve area. Sera were collected from 19 of the skunks (8 post-ORV and 11 ORV naive) and none demonstrated a rabies VNA response.

Table 3. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during the cooperative rabies management program in Maine, 2007.

	ORV naïve[a]	Post-ORV monitoring
Sample collection timeframe	13 June-20 July	5-21 Sep. 07
Last ORV date (and bait type)[b]	n/a[a]	7 Aug. 07 (FMP)
Weeks post-ORV	n/a[a]	4-7
Unique raccoons	97	126
	Serology	
Testable blood samples	74	124
Positive rabies antibody response (≥0.05 IU)	1 (1.4%)	37 (29.8%)
	Tetracycline biomarker	
Testable tooth samples	64	120
Presence of tetracycline biomarker	Not available at printing	Not available at printing

[a] Samples were collected in an ORV naïve area (never before treated with ORV).
[b] FMP=fishmeal polymer.

SUMMARY

In 2007, Maine and New Brunswick, Canada concurrently implemented rabies prevention efforts to stop the spread of raccoon variant rabies further north and east. During 2008, WS plans to continue coordination with Canada to enhance surveillance and plan ORV strategies to help prevent rabies in Maine and along the international border. Enhanced surveillance efforts, along with raccoon density studies, in northern and western Maine, will continue to help define rabies distribution and population dynamics. In addition, WS will continue to work with state agriculture, health and wildlife agencies, animal control officers, and rehabilitators to help stop the spread and ultimately eliminate terrestrial rabies in Maine.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
MARYLAND 2007

BACKGROUND

In 1981, raccoon (*Procyon lotor*) rabies first entered Maryland in Allegany County. It quickly spread and is now present throughout the state. In 1982, raccoon rabies was first documented in Anne Arundel County. In 2000, Anne Arundel County reported 43 cases of rabies, a downward trend from the 97 and 73 cases reported in 1997 and 1998, respectively. From 1996-1998 an average of 18 cases of rabies was reported from the Annapolis Peninsula alone.

In October 1998, the Anne Arundel County Department of Health (AACDH) initiated an oral rabies vaccination (ORV) program on the Annapolis Peninsula. Fishmeal polymer (FMP) baits, containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA), have been distributed each year on the Annapolis Peninsula (94 km^2) since 1998, on Gibson Island (4 km^2) since 2000, and on the Broadneck Peninsula (88 km^2) since 2001. With the assistance of Wildlife Services (WS) in 2003, ORV efforts expanded to include the entire area (1,080 km^2) of Anne Arundel County, Maryland (Figure 1). This is a cooperative effort between WS and the AACDH. Wildlife Services provides the major source of funds for project implementation.

In 2003, WS' Appalachian Ridge (AR) ORV project expanded the eastern boundary from West Virginia into Garrett County, Maryland. This project continued in 2007 and is part of a larger effort that extends from Lake Erie to Tennessee.

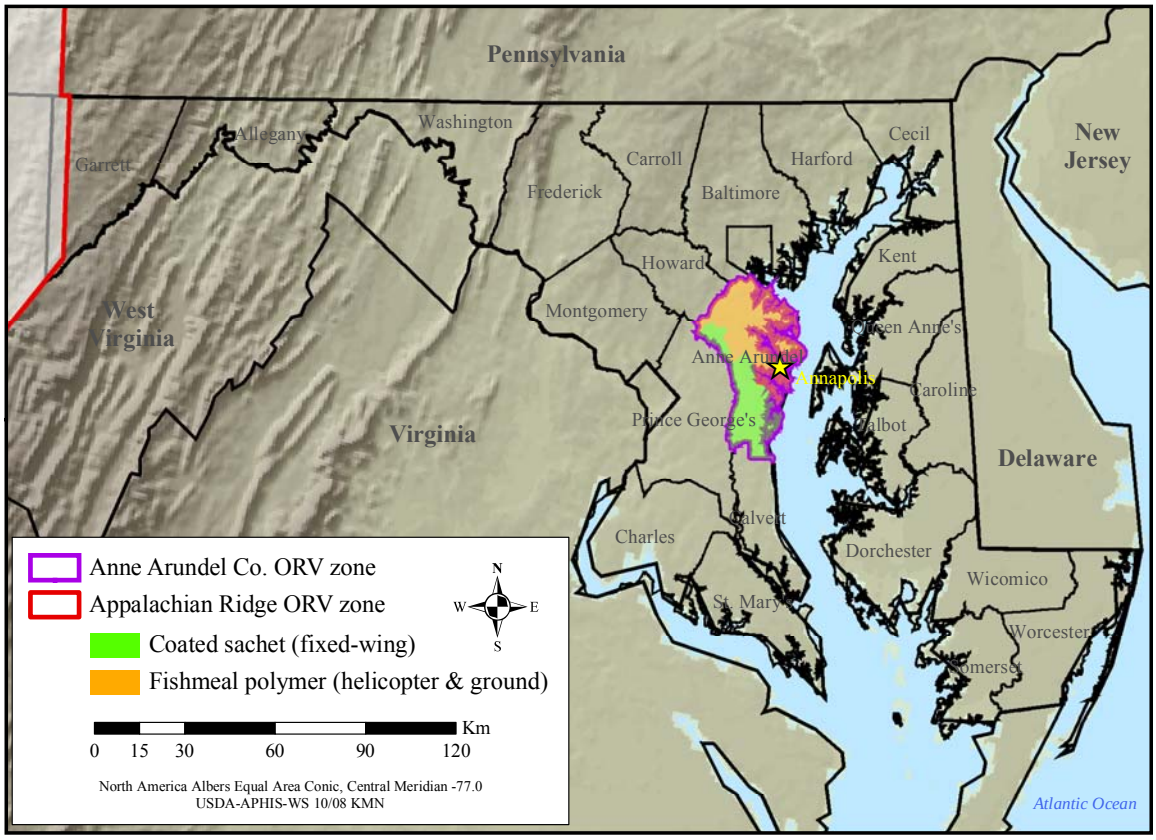

Figure 1. Wildlife Services cooperative rabies management program activities in Maryland, 2007.

ORV PROGRAM 2007

Bait Distribution

For the fifth consecutive year, WS participated in bait distribution efforts in eastern (Anne Arundel County) and western (Garrett County) Maryland; 103,038 baits were distributed over 1,389 km^2 (537 mi^2) in 2007 (Figure 1).

Appalachian Ridge.--The Maryland portion of the AR ORV zone was baited during the greater AR south campaign. From 23-28 August, WS distributed 19,523 fishmeal-coated sachet (CS) baits by fixed-wing aircraft over 306 km^2 (118 mi^2) in Garrett County. The fixed-wing aircraft and pilots were provided by the Ontario Ministry of Natural Resources, while WS provided ground support and served as navigators and flight crew in the planes. To date, WS has distributed 110,456 baits in Garrett County as part of the AR ORV zone.

Anne Arundel County.--In 2007, all of Anne Arundel County (1,083 km^2 [418 mi^2]) was baited with 83,515 ORV baits: 51,115 FMP and 32,400 (CS) (Figure 1). The CS baits were distributed over rural areas in southern Anne Arundel County by Helo Air helicopter on 18-19 September. From 6-21 September 39,460 FMP baits were distributed by Anne Arundel County Police helicopter throughout the Annapolis and Broadneck Peninsulas, and other urban and suburban areas of the county. From 4-17 September ground teams distributed 11,655 FMP baits by hand. Baiting efforts and support were provided by WS and the AACDH.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Maryland WS personnel may schedule dRIT training in the future at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

Post-ORV Monitoring

On 9 October 2007, WS initiated post-ORV trapping to collect blood and tooth samples to evaluate and monitor program success in Anne Arundel County. Over approximately 840 trap nights, WS captured 259 unique raccoons, 2 gray foxes (*Urocyon cinereoargenteus*), and 1 red fox (*Vulpes vulpes*). Additionally, WS sampled 1 raccoon that was removed from the Baltimore-Washington International Airport as part of routine wildlife damage management activities. Of these 260 raccoons, blood samples were collected from all but 2 (found dead), while tooth samples were collected from 235 raccoons. Blood samples were also collected from the 3 foxes, but no teeth. Two of the trapped raccoons were euthanized (1 due to a severe leg injury, the other because of face lesions); 2 raccoons were found dead in or near a trap; and 255 raccoons were released, along with the 3 foxes. The 4 dead raccoons were submitted for rabies testing; they all tested negative. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 63 opossums (*Didelphis virginiana*), 10 domestic/feral cats (*Felis catus*), and 4 snapping turtles (*Chelydra serpentine*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Maryland cooperates with the Maryland Department of Health and Mental Hygiene's Laboratories Administration (MDH) and the CDC.

Maryland Department of Health and Mental Hygiene's Laboratories Administration.--The MDH tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed human or domestic animal exposure). Of the 4,800 animals tested for rabies in Maryland during 2007, the MDH confirmed 431 cases of rabies: 253 raccoons, 54 bats (*Chiroptera* spp.), 49 foxes, 41 skunks, 19 cats, 6 groundhogs (*Marmota monax*), 3 cattle (*Bos taurus*), 3 dogs (*Canis lupus familiaris*), 1 black bear (*Ursus americanus*), 1 beaver

(*Castor canadensis*), and 1 otter (*Lutra canadensis*). Anne Arundel County tested 43 raccoons in which 6 were confirmed positive and Garrett County tested 11 raccoons in which 5 were positive. In 2007, raccoons represented 46.2% and 62.5% of the animals that tested positive for rabies in Anne Arundel and Garrett Counties, respectively. For more information on rabies cases by county and species in Maryland (from 2002-2007) please visit: http://edcp.org/vet_med/rabies.html

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). In 2007, the CDC analyzed serum samples from 258 raccoons, 2 gray foxes, and 1 red fox submitted by Maryland WS. This represented a 48.3% increase from the number of samples submitted by WS in 2006. The Maryland ORV program anticipates 200-300 sample submissions to this laboratory in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) data were available so they have been included instead.

Serology, Tetracycline Biomarker, and Age Results

Serology and Biomarker Results.--Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and teeth are analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

During the evaluation phase of the Maryland cooperative rabies management program, WS live-trapped 260 raccoons, 2 gray foxes, and 1 red fox following 2007 ORV bait distribution in Anne Arundel County. Samples were not collected from the AR ORV zone in Garrett County. Sera were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Rabies antibody response in raccoons has steadily increased from 19.5% in 2005 to 31.8% in 2006 to 46.1% in 2007 (Table 1). All 3 foxes demonstrated a positive rabies antibody response. Tetracycline and age data for 2007 were pending from Matson's at the time of this report.

Table 1. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during the cooperative rabies management program in Anne Arundel County, Maryland, 2007.

	Post-ORV
Sample collection timeframe	9 Oct.-16 Nov.
Last ORV date (and aerial bait type)[a]	5-21 Sep. (FMP/CS)
Weeks post-ORV	5-8
Unique raccoons	260
	Serology
Testable blood samples	258
Positive rabies antibody response (≥0.05 IU)	119 (46.1%)
	Tetracycline biomarker
Testable tooth samples	235
Presence of tetracycline biomarker	Not available at printing

[a] CS=coated sachet; FMP=fishmeal polymer.

SUMMARY

The fall of 2007 marked the fifth year of the eastward expansion of the AR ORV program in Maryland, where WS distributed 18,501 FMP baits in Garrett County. The fall of 2007 also marked the seventh year of WS cooperative participation in the AACDH ORV program. During the 3 years prior to the beginning of the AACDH

ORV program (1995-97), an average of 19 rabid animals were reported from the Annapolis Peninsula alone. Since 1998, with the intervention of 412,441 FMP baits, only 21 rabid raccoons have been reported from the Annapolis Peninsula, indicating the success of the Anne Arundel County ORV program.

In 2008, WS plans to continue its cooperative role in ORV bait distribution in Anne Arundel and Garrett Counties, and follow-up post-ORV surveillance trapping to evaluate the success of ORV in Maryland.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
MASSACHUSETTS 2007

BACKGROUND

Wildlife Services (WS) continues to support the Cape Cod Oral Rabies Vaccination program (CCORV) in southeastern Massachusetts. This cooperative project among Tufts University (TU), the Massachusetts Department of Public Health (MDPH), and the Barnstable County Department of Health and the Environment began in 1994 to reduce the incidence of terrestrial rabies in a 420-712 km^2 (162-275 mi^2) area adjacent to the Cape Cod Canal and to prevent the spread of rabies to Cape Cod, a heavily populated tourist destination south of Boston. Full time assistance from WS began in 2001 and has typically included bait purchase and distribution, membership on the Massachusetts state and Barnstable County Rabies Advisory Committees, surveillance trapping, and ORV-related wildlife research.

In 2004, the raccoon (*Procyon lotor*) variant of rabies was detected on the ocean-side of the canal and over the next 2 years spread to the outer Cape where it was confirmed in Provincetown in April 2006. The CCORV operational area now includes all townships on Cape Cod (Barnstable County). In 2007, only 5 cases of raccoon variant rabies (all raccoons) were confirmed on the Cape (Figure 1), down from 50 cases in 2006.

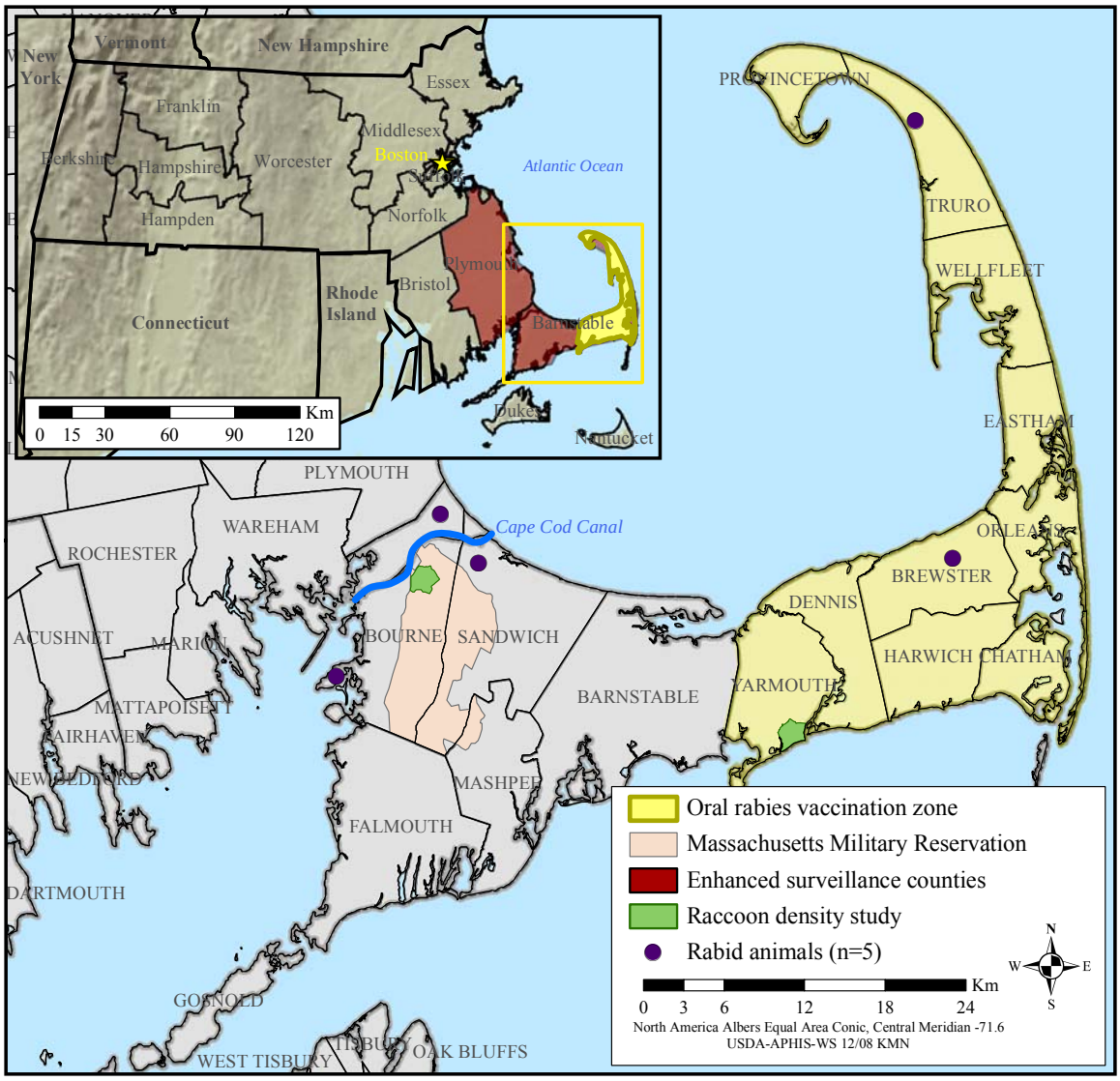

Figure 1. Wildlife Services cooperative rabies management program activities in Massachusetts, 2007.

ORV PROGRAM 2007

Bait Distribution

For the seventh consecutive year, WS participated in the CCORV program. During 2 campaigns (spring and late fall), WS and CCORV cooperators distributed 131,596 ORV baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) over approximately 494.2 km^2 (190.8 mi^2) of Cape Cod (Figure 1). Aircraft and pilots for both CCORV campaigns in 2007 were provided by the U.S. Coast Guard, while WS served as flight crew in the helicopters. Community-based volunteers were an integral part of ground operations, distributing baits in residential areas by vehicle and on foot. Since its program inception in 1994, CCORV cooperators and WS have distributed 847,913 baits in Massachusetts.

Spring Campaign.--From 30 April-25 May, portions of Cape Cod from the Yarmouth-Barnstable town boundary through Provincetown (494.2 km^2 [190.8 mi^2]) were baited at a density of 124 baits/km^2 with 60,235 ORV baits: 7,690 fishmeal-coated sachets (CS) and 1,988 fishmeal polymer (FMP) via helicopter; 14,380 CS and 34,377 FMP via ground operations; and 1,800 FMP via bait stations (24 stations were used for 4 weeks in South Yarmouth on the 3-km^2 area that was also used for a raccoon density study). This entire area of the Eastern Cape was baited again in the fall 2007 (see *Late Fall Campaign* below).

Late Fall Campaign.--From 5-19 November 2007, the *Early Summer Campaign* was repeated. This area was baited with 71,361 ORV baits (144 baits/km^2): 7,020 CS and 1,704 FMP via helicopter; 16,200 CS and 42,837 FMP via ground operations; and 3,600 FMP via bait stations (24 stations were again used for 3.5 weeks in South Yarmouth).

Enhanced Surveillance

In March 2004, WS and cooperators implemented an enhanced rabies surveillance program that continued through 2007 to track the rabies epizootic on Cape Cod for planning purposes, epidemiological data collection, and reduction of municipal infrastructure-based variation in specimen submissions. Primary activities of the CCORV enhanced surveillance program included the collection, preparation, and transportation of samples to the MDPH Laboratory Institute for rabies testing. These specimens were collected via public reports of sick or strange behaving animals to municipal officials, nuisance wildlife trapping, and road kill surveys.

Wildlife Services (in cooperation with CCORV partners) submitted 151 specimens to the MDPH Lab as part of an enhanced rabies surveillance program; 4 of these were confirmed rabid. Total samples included: 111 raccoons, 19 striped skunks (*Mephitis mephitis*), 8 red foxes (*Vulpes vulpes*), 5 coyotes (*Canis latrans*), 4 bats (*Chiroptera* spp.), 2 feral cats (*Felis catus*), 1 opossum (*Didelphis virginiana*), and 1 cottontail rabbit (*Sylvilagus floridanus*). Twenty-seven of these specimens were obtained off-Cape in the historic ORV zone (19 raccoons, 6 skunks, 1 bat, and 1 red fox). Two more raccoons were collected and tested from off-Cape, but outside of the historic ORV zone. All of the 29 specimens tested from off-Cape (outside of Barnstable County), were negative for rabies. Five specimens (4 raccoons and 1 skunk) from Barnstable County were not tested because sample condition was unsuitable. Of the 117 animals submitted by WS and tested by the MDPH from Barnstable County, 4 (3.4%) tested positive for rabies (Table 1). Of all Barnstable County specimens tested by the MDPH (including samples submitted by WS and other entities), only 5 raccoons tested positive for rabies in 2007 from the towns of Bourne, Sandwich, Brewster, and Truro. One of the 2 rabies-positive Bourne raccoons was collected from the mainland side of the Cape Cod Canal (Figure 1).

Table 1. Rabies in raccoon and skunk surveillance specimens submitted by Wildlife Services and tested by the Massachusetts Department of Public Health, Laboratory Institute from various sources in Barnstable County, Massachusetts, 2007; table does not include specimens submitted directly by municipal governments.

Source	Raccoons submitted	Raccoons suitable for testing	Rabies positive raccoons[a]	Skunks submitted	Skunks suitable for testing	Rabies positive skunks[b]
Rehab center/Veterinary clinic	46	45	1 (2.2%)	5	5	0
Complaint-based: residential property	32	32	3 (9.4%)	6	5	0
Road killed	10	7	0	0		
Recreation area	1	1	0	0		
Unknown	1	1	0	2	2	0
Total	90	86	4 (4.7%)	13	12	0

[a] Percentage = (# rabies positive ÷ # animals suitable for testing) x 100.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and reduce rabies laboratory burden, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

An adequate space was not available for implementation of the dRIT during 2007. Construction efforts are currently underway to install a necropsy station adjacent to the WS Field Office in Sutton, MA which will accommodate the dRIT process. Once full-scale dRIT use is underway, all positives, 10% of negatives, and all indeterminate samples will be sent to the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia for confirmation and strain typing.

Population Monitoring

In July 2007, WS conducted its second annual raccoon density study in South Yarmouth (Figure 1) in collaboration with the Yarmouth Department of Natural Resources. The study site was within an area of coastal recreational communities with high human densities, mostly comprised of backyards and small wetlands. The National Rabies Management Program (NRMP) standard protocol of 50 cage traps set on a target study area of 3 km^2 (1.2 mi^2) for 10 consecutive nights was used. Wildlife Services captured 27 unique raccoons for an index to density of 8.8 raccoons/km^2, slightly higher than the 2006 density (Table 2). In addition, WS trapped 9 unique skunks for processing. Twenty-six raccoons and 7 skunks were chemically immobilized and hand vaccinated with 1 ml of Imrab3® rabies vaccine (Merial Limited) and released. Blood sera and a tooth were collected from most of the raccoons and skunks for ORV program evaluation and other morphological characteristics were also recorded. One juvenile skunk was released without processing (too small to process). One skunk died in captivity and 1 raccoon was found dead in a trap; both were deemed unsuitable for rabies testing.

Wildlife Services also conducted a raccoon density study in September for the first time on the Massachusetts Military Reservation (MMR), an Army National Guard Training Site, comprised mostly of pitch pine (*Pinus rigida*) and scrub oak (*Quercus ilicifolia*) forests. In addition to providing information for CCORV management decisions, estimating raccoon densities in this habitat type may aid in planning for other eastern seaboard areas with similar habitat types. During this study, the NRMP "low density" protocol of 50 cage traps set on a target study area of 3 km^2 (1.2 mi^2) over 5 consecutive nights (reduced trap nights in response to low capture rate) was used. Two unique raccoons were captured for an index to density of 0.7 raccoons/ km^2. As in the July study, raccoons were chemically immobilized, processed for blood and tooth collection, hand vaccinated, and released. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 2. Index to raccoon densities in Barnstable County, Massachusetts, 2007.

	Yarmouth 2006	Yarmouth 2007	Bourne 2007
Time of study	15-25 July	15-25 July	24-29 Sep.
Macrohabitat	Urban/suburban	Urban/suburban	Forested
Target trap nights	500	500	250
Unique raccoons	20	27	2
Recaptured raccoons	8	11	0
Non-target captures[a]	34	63	2
Area (km^2)	3.06	3.06	3.05
Raccoon density index[b]	6.5	8.8	0.7

[a] Includes skunks.
[b] Unique raccoons/km^2.

Post-ORV Monitoring

In 2007, rabies surveillance efforts again took precedence over post-ORV trapping as WS monitored the rabies epizootic throughout Cape Cod. Therefore, post-ORV trapping was conducted secondarily to the surveillance effort from 22-24 October (22 weeks after spring baiting). Wildlife Services live-trapped 11 unique raccoons over 68 trap nights. Blood and tooth samples were collected from all of them and they were hand vaccinated prior to release. The 27 raccoons trapped in the July density study (Yarmouth) were sampled 7-8 weeks after spring baiting. The Bourne study site (MMR) was not baited in the spring of 2007.

Non-target Captures

Non-target (not processed, sampled, or vaccinated) animals captured and released by WS in 2007 included: 66 opossums, 1 feral/domestic cat, 1 cottontail rabbit, and 1 box turtle (*Terrapene carolina*).

Rabies Laboratory Cooperation

Wildlife Services in Massachusetts cooperates with the MDPH Lab and the CDC as a particpant in the CCORV.

Massachusetts Department of Public Health Laboratory Institute.--The MDPH Lab tests animal brainstems for rabies by dFA as part of routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Animal Control and Public Health Officials) and enhanced surveillance (specimens not involved in an exposure and usually submitted by WS from Barnstable and Plymouth Counties or municipal officials statewide). In 2007, the MDPH Lab received 2,802 specimens for rabies testing from all 14 counties, representing a 3.7% decrease from the number of samples received statewide in 2006. Of these, 249 (8.9%) came from within the current ORV zone (Barnstable County), representing a 4.6% decrease from the number of samples submitted from Barnstable County in 2006. The number of raccoons submitted from Barnstable County in 2007 (103) was down compared to 2006 (300), as well as the percentage of raccoons testing positive for rabies in the county (4.9%), down considerably from 2006 (45.0%). Statewide, the MDPH Lab confirmed 152 rabid animals in 2007 (Table 3): 71 raccoons, 38 skunks, 28 bats, 7 cats, 3 foxes, 2 woodchucks (*Marmota monax*), 1 bobcat (*Lynx rufus*), 1 coyote, and 1 dog (*Canis lupus familiaris*).

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These are common rabies reservoir throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance across the nation. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 83.0% of the animals submitted for rabies testing in Massachusetts in 2007 are reported by WS as “other.” For a more detailed listing of rabid animals from Massachusetts in 2007 (and prior years dating back to 1992) please visit: http://www.mass.gov/?pageID=eohhs2homepage&L=1&L0=Home&sid=Eeohhs2 and search on "rabies."

Table 3. Animals submitted for rabies testing to the Massachusetts Department of Public Health Laboratory Institute in Massachusetts, 2007.

	Submissions	Rabies Positive
Raccoons	272	71 (26.1%)
Skunks	153	38 (24.8%)
Foxes	38	3 (7.9%)
Coyotes	14	1 (7.1%)
Other[a]	2,325	39 (1.7%)
Total	2,802	152 (5.4%)

[a] Other animals included: alpacas, bats, cats, chipmunks, cows, deer, dogs, ferrets, goats, horses, kangaroo, llamas, mice, mink, moles, muskrats, opossums, pig, rabbits, rats, porcupines, sheep, shrew, squirrels, weasels, and woodchucks.

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA) in support of the CCORV program. Massachusetts WS will submit 55 blood serum samples (10 from December 2006 and 45 from 2007) to the CDC in June 2008. Massachusetts WS anticipates an increase in numbers of serum sample submissions to the CDC from 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2005, 2006, and 2007 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

Serum samples collected during 2007 and fall 2006 will be sent to the CDC for rabies VNA analysis in June 2008. Tooth samples collected during 2005, 2006, and 2007 were submitted to Matson's Laboratory LLC (Milltown, Montana, USA) for age and biomarker analysis in October 2007, but were unavailable at the time of this report.

SUMMARY

In 2007, WS completed its seventh year of cooperative participation in rabies management on Cape Cod, Massachusetts. Wildlife Services continued to work with cooperators to develop optimal rabies control strategies. In addition, enhanced rabies surveillance behind the front to track epizootic intensity and public information campaigns were priorities of the CCORV program in 2007. A 3 km^2 (1.2 mi^2) study area located in South Yarmouth was used for a density study, as well as a new study area on the MMR in Bourne. The experimental use of bait stations also continued in an attempt to optimize ORV bait delivery in the South Yarmouth study area.

In 2008, the CCORV program's goal is to implement and evaluate strategies for restoring Cape Cod to raccoon rabies-free status and creating a new, appropriate ORV zone on the west side of the Cape Cod Canal to prevent rabies from spreading back onto the Cape.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
MICHIGAN 2007

BACKGROUND

To date, there have been no reported cases of the raccoon (*Procyon lotor*) variant of rabies in Michigan, although other variants (including bat [*Chiroptera* spp.] and North Central striped skunk [*Mephitis mephitis*]) do occur. Given its close proximity to both Ohio and Ontario, Canada however, where raccoon rabies is known to exist, the state of Michigan established a multi-agency rabies working group in 1997. The goals of the group are to: educate the public; provide expertise and recommendations on rabies issues; conduct research; prevent an increase in the disease and risk for existing variants; and prevent the establishment of new variants (raccoon rabies in particular). The Michigan rabies working group developed a contingency plan for the introduction of raccoon rabies, should it occur. The plan was adopted by Wildlife Services' (WS) National Rabies Management Program (NRMP) and has been implemented in areas where raccoon rabies approached or breached an oral rabies vaccination (ORV) zone, or was confirmed where it was not formerly known to exist. The Michigan rabies working group has also developed an enhanced surveillance system (ESS) to aid in the early detection of raccoon rabies. Through guidance and training from the NRMP, biologists from WS and the Michigan Departments of Natural Resources (MDNR) and Community Health (MDCH) began implementing the ESS in 2005. Therefore, 2007 marked the third year that raccoon rabies enhanced surveillance activities took place in Michigan.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

There is currently no ORV bait distribution program in Michigan.

Enhanced Surveillance

In 2007, a total of 35 enhanced surveillance specimens were collected in 19 counties (Figure 1) and processed by WS. Animals included: 17 raccoons, 13 gray foxes (*Urocyon cinereoargenteus*), 3 striped skunks, and 2 coyotes (*Canis latrans*) (Table 1). All animals were displaying signs of a neurological disorder and were collected by cooperators, such as nuisance wildlife control operators, local animal control officers, and MDNR staff. These "rabies suspect" animals are very desirable for enhanced surveillance and were submitted in an effort to increase rabies awareness in those that might receive calls for assistance from the public. Brainstem and tooth samples were collected from each animal and hair samples were collected from raccoons for DNA analysis. All animals tested negative for the rabies virus. In 2007, no animals were trapped by WS specifically for enhanced rabies surveillance.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

During 2007, WS tested the 35 animals mentioned above using the dRIT. Ten percent of the negative samples were sent to the Centers for Disease Control and Prevention (CDC) for confirmation. The CDC (using the dFA test) had 100% agreement with the WS dRIT test results for negative samples. The MDNR continues to cooperate in the implementation of the dRIT by providing the use of their Wildlife Disease Biosafety Level 2 (BSL-2) Laboratory. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Michigan.

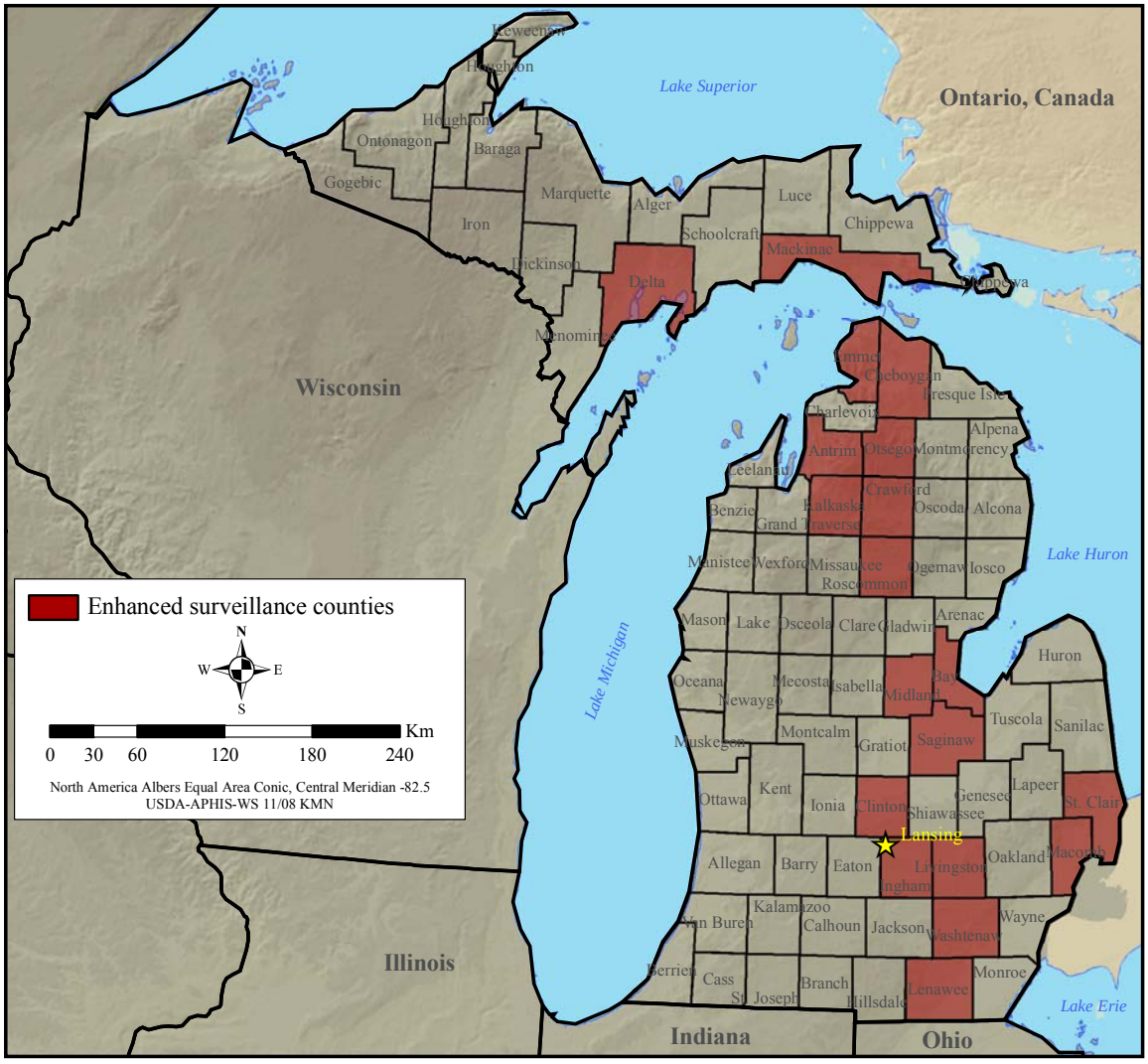

Figure 1. Wildlife Services cooperative rabies management program activities in Michigan, 2007.

Rabies Laboratory Cooperation

Wildlife Services' rabies management program in Michigan cooperates with the MDCH Bureau of Laboratories (BOL) and the CDC.

Michigan Department of Community Health Bureau of Laboratories.--The BOL tests cross-sections of animal cerebellums and brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure) and cross-sections of the brainstems for enhanced surveillance (specimens not involved in an exposure and usually submitted by WS or the MDNR). Specimens are tested at the BOL using the dFA test. The BOL received 3,863 samples for rabies virus testing in 2007, representing a 34.4% increase from the number of samples submitted in 2006. The BOL did not test 150 of these samples because they were either unsatisfactory or were from non-rabies vector species (i.e., small rodents and lagomorphs). An additional 9 samples yielded inconclusive rabies results. Of the 3,704 samples that yielded results, 210 (5.7%) tested positive for the rabies virus (Table 1).

Raccoons, skunks, and foxes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 96.5% of the

animals tested for rabies in Michigan in 2007 (that yielded results) are reported by WS as "other." For more information on current and historical rabies cases in Michigan please visit the Michigan Emerging Disease Issues website at: http://www.michigan.gov/emergingdiseases/ and click on the "rabies" link on the left side.

Table 1. Animals submitted and tested for rabies by the Michigan Department of Community Health Bureau of Laboratories (BOL) and the Michigan Wildlife Services (WS) Program in 2007.

	Public Health Surveillance (BOL)		Enhanced Surveillance (WS)	
Species	**Submissions**	**Rabies Positive**	**Submissions**	**Rabies Positive**
Raccoons	98	0	17	0
Skunks	22	5 (22.7%)	3	0
Foxes	8	2 (25 %)	13	0
Other[a]	3576	203 (5.7%)	2	0
Total	3704	210 (5.7%)	35	0

[a] Other animals included: bats, coyotes, domestic cats, and sheep.

Centers for Disease Control and Prevention.--The CDC tests animal brainstems from Michigan WS for rabies as part of enhanced surveillance dRIT confirmation. In 2007, WS submitted 3 samples for dRIT confirmation and all 3 were confirmed negative by the CDC using the dFA test. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

RABIES MANAGEMENT PROGRAM 2006 – EVALUATION

Serology, Tetracycline Biomarker, and Age Results

Animal blood sera are analyzed to detect rabies virus neutralizing antibodies (VNA) and teeth are analyzed to determine animal age and bait uptake. Fishmeal polymer (FMP) baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; fishmeal coated sachet baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well. Also, tetracycline can be picked up from other items in the environment other than FMP baits.

There is no ORV baiting program in Michigan, therefore the specimens collected for enhanced surveillance are considered "ORV naïve" (not previously treated with ORV) and were not submitted for tetracycline screening in 2006, however, 112 tooth samples were collected for aging purposes. These samples will be sent to the MDNR's Wildlife Disease Laboratory in the summer of 2008 as part of a comparative study between the MDNR lab and Matson's Laboratory LLC (Milltown, Montana, USA), where both labs receive tooth samples from the same animals for aging. The NRMP may be interested in developing a relationship with another tooth analysis lab to improve sample turnaround times and reduce costs.

Serum samples were submitted for 50 animals (49 raccoons and 1 skunk) collected during 2006 population monitoring activities. One raccoon (2.0%) demonstrated a positive rabies VNA response (≥0.05 IU).

SUMMARY

During 2007, WS completed its third year of participation in cooperative rabies management efforts in Michigan. Wildlife Services began an educational campaign of local health department staff, human and animal healthcare providers, animal and wildlife control officers, local law enforcement officers, and other personnel from state and federal agencies. The education of these critical stakeholders will increase the efficiency of sample collection throughout the state and thereby enhance surveillance for raccoon rabies in Michigan. Although the number of samples collected was relatively low in 2007, the program gained valuable cooperation and started receiving non-exposure "rabies suspect" animals from a variety of sources. In 2008, these outreach efforts will continue and hopefully will expand the enhanced surveillance system.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
MISSISSIPPI 2007

BACKGROUND

The raccoon (*Procyon lotor*) variant of the rabies virus has not been documented in Mississippi. In 1964, rabies was first detected in bats (*Chiroptera* spp.) within Mississippi. The last indigenous case of rabies in a dog (*Canis lupus familiaris*) occurred in 1961. In 1965, two puppies imported from another state were confirmed rabid before they came into contact with other animals. Since World War II, 14 cases of human rabies have occurred in the state, the last being in 2005. Most of these cases are suspected to have been canine rabies (Dr. Brigid Elchos, Mississippi Department of Health [MDH], pers. comm.). These cases were located throughout the state. The most recent case was in September 2005; a child who died and had elevated rabies titer levels. A bat was reportedly in his bedroom in April 2005. The child was cremated so no post-mortem exam to reveal more information about the cause of death could be performed.

Extensive rabies vaccination programs for dogs have been conducted over the last several decades. As the number of dogs vaccinated against rabies increased, the number of positive animals confirmed by the MDH Laboratory decreased. Currently, only the bat variant of rabies is considered enzootic within Mississippi (Riecken 1984). The nearest confirmed case of raccoon rabies to Mississippi has been in Clarke County, Alabama (Figure 1). As a result of the proximity of Clarke County cases, Wildlife Services (WS) in Mississippi began an enhanced rabies surveillance program in 2003 to detect raccoon rabies, should it enter the state.

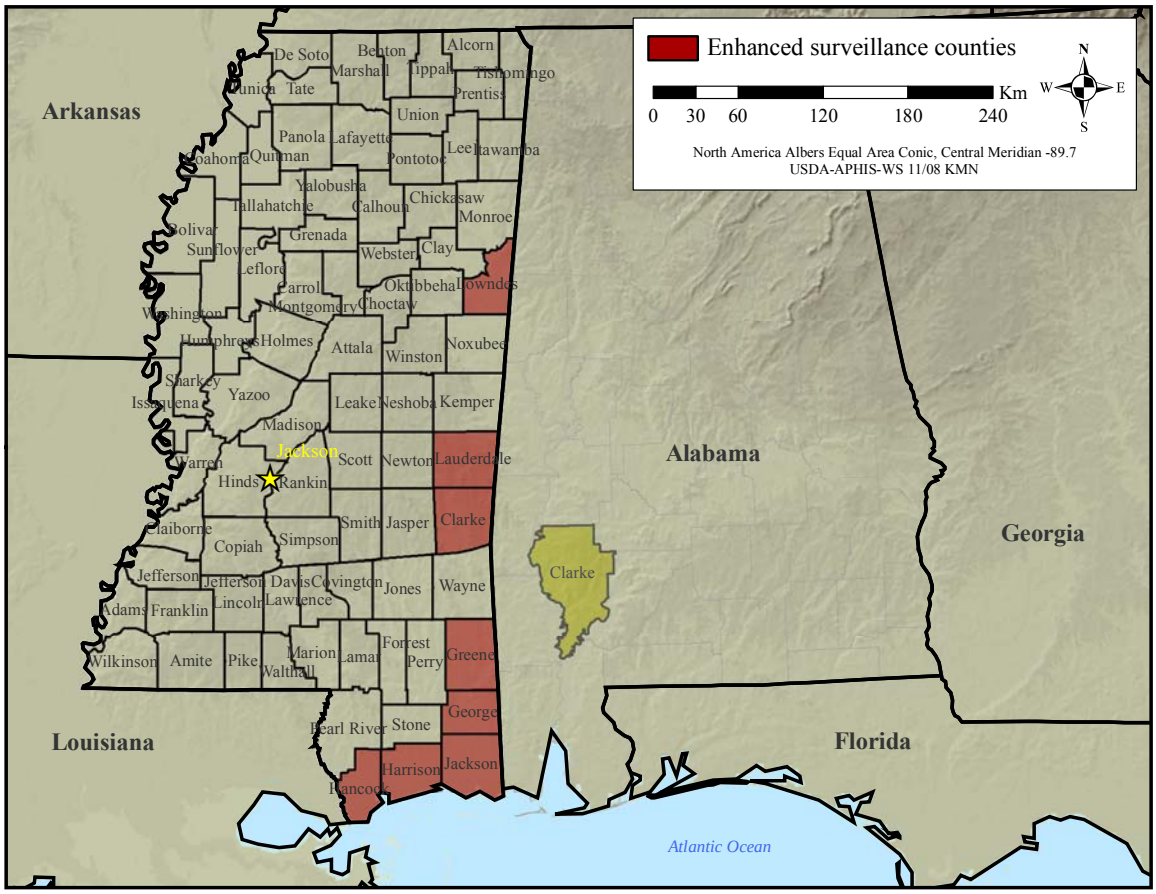

Figure 1. Wildlife Services cooperative rabies management program activities in Mississippi, 2007.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

There is currently no oral rabies vaccine (ORV) bait distribution program in Mississippi.

Enhanced Surveillance

In 2007, WS continued enhanced surveillance of rabies by collecting road killed, suspect rabid, or nuisance raccoons, striped skunks (*Mephitis mephitis*), red foxes (*Vulpes vulpes*), gray foxes (*Urocyon cinereoargenteus*), and coyotes (*Canis latrans*) in Clarke, George, Greene, Hancock, Harrison, Jackson, Lauderdale, and Lowndes Counties, of Mississippi (Figure 1).

Wildlife Services cooperated with wildlife law enforcement officers, city animal control officers, and various county officials to collect 76 animal brainstem samples from Mississippi (Table 1). All samples were tested by a WS technician using the direct rapid immunohistochemistry test (dRIT) in Gulfport, MS. All samples tested negative for the rabies virus.

Table 1. Animals tested for rabies by Wildlife Services using the Direct Rapid Immunohistochemistry Test (dRIT) in Mississippi, 2007 (no rabies positives confirmed).

County	Raccoon	Striped skunk	Red fox	Gray fox	Coyote	Total
Clarke	1					1
George					1	1
Greene	1					1
Hancock	3	1				4
Harrison	32	1	1			34
Jackson	15					15
Lauderdale	5			4		9
Lowndes	10				1	11
Total	67	2	1	4	2	76

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

One Mississippi WS personnel attended dRIT training in April 2006 at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. Wildlife Services implemented the test in 2006 (testing 106 samples) and tested the 76 samples mentioned above in 2007. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Mississippi.

Rabies Laboratory Cooperation

The WS cooperative rabies management program in Mississippi currently collaborates with the MDH, Public Health Laboratory (PHL). The PHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by veterinarians) and when needed, via enhanced surveillance (specimens not involved in an exposure, usually submitted by WS). On average, the PHL tests over 400 animals for rabies each year (primarily domestic cats [*Felis catus*] and dogs). Numerous bats are also submitted each year. The PHL confirmed 3 cases of rabies in Mississippi in 2007; they were all bats.

For the past 3 years, WS has assisted the PHL by purchasing various rabies testing supplies (e.g., pipettes, gloves, shipping boxes, etc.). Wildlife Services implemented the dRIT in 2006 to relieve some of the rabies testing burden on the PHL, but still anticipates similar numbers of submissions to the lab. For more information about rabies in Mississippi please visit: http://www.msdh.state.ms.us and search on "rabies."

SUMMARY

During 2007, WS completed its fifth year of participation in cooperative rabies management efforts in Mississippi. The focus of activities for 2007 continued to be enhanced rabies surveillance in the southeastern part of the state where it borders Alabama. In 2008, efforts will continue to focus on enhancing surveillance in these areas to detect the raccoon variant of the rabies virus, should it spread from nearby Alabama.

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Riecken, W.E. Jr. 1984. Review of Rabies in Mississippi. Mississippi Morbidity Report (June). Mississippi Department of Health. Vol 2,11:1-3.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
NEW HAMPSHIRE 2007

BACKGROUND

The first case of raccoon (*Procyon lotor*) rabies confirmed in New Hampshire was a bit of an anomaly. In March 1992, a raccoon entered a local police officer's house in Rumney and began fighting with the family Doberman (Figure 1). The officer was forced to shoot the raccoon under the kitchen table. The raccoon was brought to a local veterinarian's office and was found to be wearing 2 flea collars, likely to be a "pet" of unknown origin (retired State Veterinarian Dr. Clifford McGinnis, New Hampshire Department of Agriculture, Markets and Food [NHDAG], personal communication in 2002). The raccoon was confirmed rabid on 6 April with the raccoon variant of rabies. Rumney is approximately 128 km (80 mi) north of the New Hampshire-Massachusetts state border and officials believed the family caring for the raccoon translocated it from a rabies-infected area in southern New England. Fortunately, no additional cases were detected in the Rumney area, but the raccoon variant of the rabies virus did enter New Hampshire in the fall of 1992, as an extension of the epizootic in southern New England. Once in New Hampshire, raccoon rabies continued its northward spread at a rate of about 40 km (25 mi) a year. Raccoon rabies has been confirmed in all 10 counties, with the northernmost case occurring in Lancaster (in 1999) approximately 60 km (37.5 mi) south of the United States-Canada border (Figure 1).

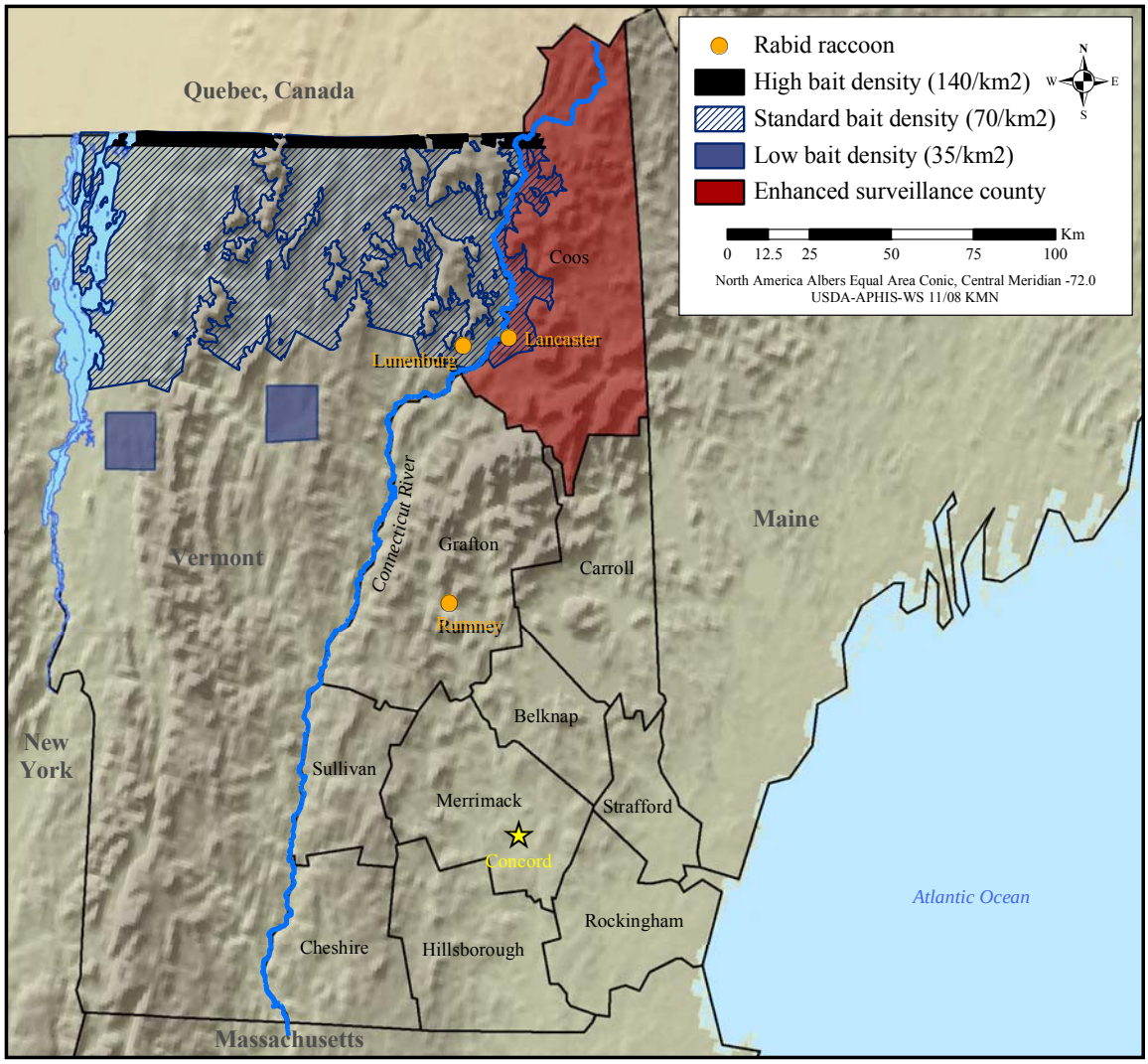

Figure 1. Wildlife Services cooperative rabies management program activities in New Hampshire, 2007.

Just months after the Lancaster, New Hampshire case was documented, a rabid raccoon was confirmed in Lunenburg, Vermont (19 October 1999) directly across the Connecticut River (state border) from Lancaster (Figure 1). This prompted concern over the spread of rabies through the Connecticut River Valley in northern New Hampshire and Vermont into Canada. In July 2001, Wildlife Services (WS) conducted a raccoon density study in northern New Hampshire to better understand the population there and the potential movement of rabies. In August 2001, an oral rabies vaccination (ORV) program was initiated in New Hampshire with the goal to prevent the northward spread of raccoon rabies.

The New Hampshire ORV program has been a cooperative effort between WS, Cornell University (CU), the NHDAG, the New Hampshire Department of Health and Human Services (NHDHHS), and the New Hampshire Department of Fish and Game. Wildlife Services has been the major source of federal funds for project implementation. Wildlife Services has also provided federal wildlife management leadership by continuing to play an active role in: program planning and coordination; organizing ground support for aerial bait distribution; working in and navigating aircraft to distribute baits; coordinating the hand distribution of baits in areas too populated to bait by air; and providing surveillance and follow-up field work by collecting blood and tooth samples from live-trapped and suspect-rabid animals within the New Hampshire ORV bait zone to test program efficacy.

ORV PROGRAM 2007

Bait Distribution

For the sixth consecutive year in 2006, WS participated in ORV bait distribution efforts along the upper Connecticut River Valley in northern New Hampshire, coinciding with Vermont aerial bait distribution activities; 31,905 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 552.5 km^2 (213.3 mi^2) of Coos County (Figure 1). From 7-9 August, 31,355 CS baits were distributed by fixed-wing aircraft over northern New Hampshire, while 550 FMP baits were distributed by hand in the villages of Colebrook and Lancaster on 7 August (Figure 1). Pilots and mechanics for aerial baiting were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS provided navigators, flight crew, and ground support. Since its program inception in 2001, WS has distributed 179,997 ORV baits in New Hampshire.

Enhanced Surveillance

Enhanced rabies surveillance includes collection of road killed, strange acting, and nuisance animals not involved in a rabies exposure that may otherwise have not been tested through the public health surveillance system. In 2007, 2 raccoons and 1 skunk were collected during road kill surveillance in Coos County, New Hampshire. Only 1 sample was submitted for rabies testing and it was negative. This area of northern New Hampshire is very rural with low human population (7/km^2 [18/mi^2], U.S. Census Bureau 2000) and few roads, and therefore produces very few road killed specimens for testing.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, New Hampshire WS is not planning training or implementation of the dRIT because the NHDHHS is meeting enhanced surveillance testing needs.

Post-ORV Monitoring

From 25-27 September 2007, Vermont WS conducted post-ORV trapping activities in Coos County, New Hampshire. Over 40 trap nights, 10 unique raccoons were trapped and blood serum and tooth samples were collected from all of them to measure rabies virus neutralizing antibody (VNA) response in the ORV zone. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Non-target Captures

No non-target species were captured in New Hampshire in 2007.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in New Hampshire cooperates with the NHDHHS, Public Health Laboratory (PHL) and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC).

New Hampshire Department of Health and Human Services, Public Health Laboratory.--The PHL routinely tests animal brainstems for rabies via public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Conservation Officers, veterinarians, and the public). When possible, the PHL tests specimens not involved in an exposure to enhance surveillance in towns which have not yet had a confirmed case of rabies. The PHL tested 590 brainstem samples for the rabies virus in 2007 (Table 1). This represents a 1.7% increase from the number of samples tested in 2006. The 2007 samples were submitted from all 10 counties throughout the state and 54 tested positive for rabies, similar to the 48 positives in 2006.

Raccoons, skunks (*Mephitidae* spp.), foxes (*Canidae* spp.), coyotes (*Canis latrans*), and bobcats (*Lynx rufus*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 84.9% of the animals tested for rabies in New Hampshire in 2007 are reported by WS as "other." For more information about rabies in New Hampshire please visit: http://www.dhhs.state.nh.us/DHHS/CDCS/rabies.htm

Table 1. Animals tested for rabies by the New Hampshire Department of Health and Human Services, Public Health Laboratory in New Hampshire, 2007 (rabies positives statewide and percent of animals tested from enhanced surveillance zone in parentheses).

	Statewide	Within and adjacent[a] to New Hampshire ORV zone
Raccoons	48 (22)	0
Skunks	31 (17)	1 (3.2%)
Foxes	8 (2)	0
Coyote	1	0
Bobcat	1	0
Other[b]	501 (13)	7 (1.4%)
Total	590 (54)	8 (1.4%)

[a] Samples were from areas inside or ≤ 6 km (10 mi) outside the ORV zone.
[b] Other animals included: bats (9 rabid), domestic pets (1 rabid cat, 1 rabid swine), and woodchucks (2 rabid).

New York State Department of Health's Rabies Laboratory at the Wadsworth Center.--The WC analyzed 10 serum samples from New Hampshire for rabies VNA submitted by Vermont WS in 2007. This was similar to the number of samples submitted by WS in 2006 (n=11). The Vermont/New Hampshire ORV program anticipates similar numbers of submissions to the WC in 2008. For more information about the Rabies Laboratory at the WC please visit: http://www.wadsworth.org/rabies/

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake. Fishmeal polymer baits contain a chemical biomarker (tetracycline) that stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker. Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, during the evaluation phase of the New Hampshire cooperative rabies management program, WS live-trapped 10 unique raccoons within the ORV bait zone. Blood and tooth samples were collected from all of these animals and serum samples were sent to the WC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). One of 10 (10.0%) serum samples collected 7 weeks post-2007 ORV demonstrated a positive rabies VNA response (serum titer $\geq$ 0.05 IU/ml). Six teeth were testable for biomarker, but none showed a presence of tetracycline. However, CS baits were distributed in 2007. Age results were pending at the time of this report.

SUMMARY

During 2007, WS completed its seventh year of participation in cooperative rabies management efforts in New Hampshire. The focus of activities this year was ORV bait distribution and follow-up post-ORV monitoring (trapping). The New Hampshire ORV program is an important part of a larger northeastern cooperative effort, which in 2007 included: New York; Vermont; Maine; and Ontario, Quebec, and New Brunswick, Canada. The Northeastern cooperative effort is tied to national planning efforts to contain and explore strategies to eliminate the raccoon variant of the rabies virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
NEW JERSEY 2007

BACKGROUND

In the early part of the twentieth century New Jersey had a significant problem with rabies in dogs (*Canis lupus familiaris*); in 1939, 675 dogs and 4 humans died of rabies in the state. In 1942, a rabies management program involving mass vaccination of dogs and collection of stray animals was initiated. As a result of these efforts New Jersey experienced its last case of canine rabies in 1956. In 1960, the first case of bat (*Chiroptera* spp.) rabies was confirmed in New Jersey. The raccoon (*Procyon lotor*) rabies epizootic spread to New Jersey through Warren and Hunterdon Counties in 1989. In 1991, New Jersey led the nation in animal rabies cases per capita. The scale of the outbreak stimulated public support for a safety and efficacy trial of an oral rabies vaccine (ORV) in wild raccoons by the State of New Jersey and Thomas Jefferson University, Philadelphia, Pennsylvania. Between 1989 and 2005, 4,938 cases of terrestrial rabies were confirmed. Of these, 3,681 (74.5%) were raccoons.

From 1992-1994, the New Jersey Division of Fish and Wildlife worked cooperatively with the Cape May County Department of Health (CMDH) and the New Jersey Department of Health and Senior Services (NJDHSS) to conduct an experimental ORV program on the rabies-free peninsula of Cape May County (Figure 1). Since 1995, the CMDH has worked independently to distribute ORV baits in Cape May County. In 2004, Wildlife Services (WS) became involved in the ORV program to assist county and state cooperators with project evaluation.

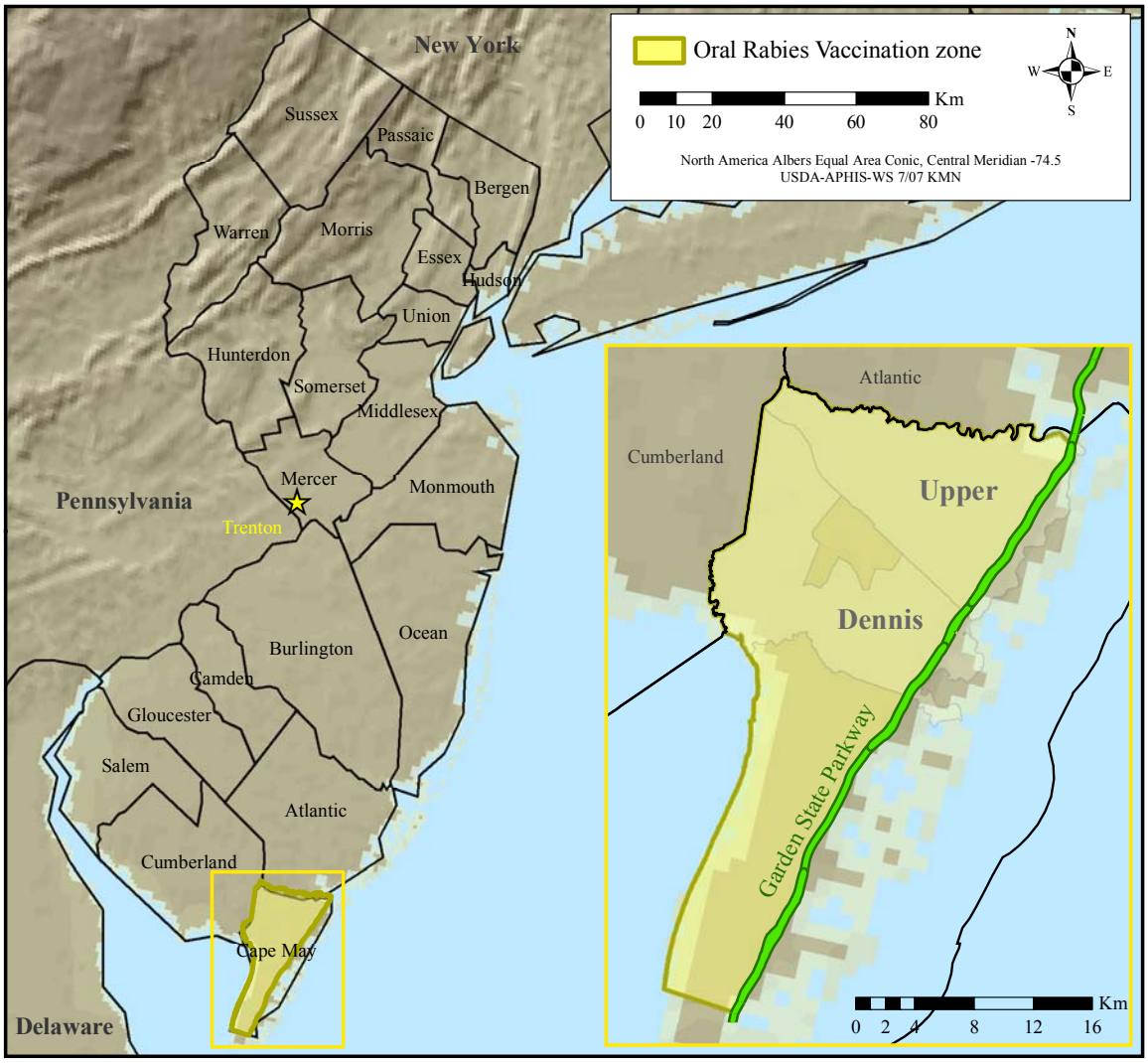

Figure 1. Wildlife Services cooperative rabies management program activities in New Jersey, 2007.

ORV PROGRAM 2007

Bait Distribution

In 2007, the ORV bait zone in Cape May County encompassed 556 km² (215 mi^2) west of the Garden State Parkway (Figure 1). From 24 September-12 October, 45,600 ORV baits containing Raboral V-RG® vaccine (Merial Limited, Athens Georgia, USA) were distributed: 42,600 fishmeal coated sachet (CS) baits by helicopter provided by the New Jersey Mosquito Commission, and 3,000 fishmeal polymer (FMP) baits by hand. Although baits are distributed at a rate of approximately 82 baits/km², emphasis is placed on Upper and Dennis Townships to prevent the spread of rabies from neighboring Atlantic and Cumberland Counties into Cape May County. Since 1991, approximately 393,600 baits have been distributed in Cape May County.

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Currently, New Jersey WS is not planning training or implementation of the dRIT.

Post-ORV Monitoring

No post-ORV monitoring activities were conducted in New Jersey during 2007.

Rabies Laboratory Cooperation

New Jersey WS cooperates with the NJDHSS, Public Health and Environmental Laboratory (PHEL) and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC).

New Jersey Department of Health and Senior Services, Public Health and Environmental Laboratory.--The PHEL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by County Health Officers, veterinarians, and the public). The PHEL tested 3,398 animals for the rabies virus in 2007 (Table 1), representing a 2.1% increase from the number of samples tested statewide in 2006. Of the animals tested in 2007, 284 were confirmed positive and of those 163 (57.4%) were raccoons. There was one positive case involving a raccoon reported from Cape May County. Although rabies positive cases are rare in Cape May County due to the county operated ORV program, sporadic positive cases occasionally occur along the northern Cape May County border.

Raccoons, skunks (*Mephitidae* spp.), foxes (*Canidae* spp.), and coyotes (*Canis latrans*) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 85.9% of the animals tested for rabies in New Jersey in 2007 are reported by WS as "other." For more information on 2007 rabies cases in New Jersey please visit: http://www.state.nj.us/health/cd/documents/rabcases07.pdf

Table 1. Animals tested for rabies by the New Jersey Department of Health and Senior Services, Public Health and Environmental Laboratory in New Jersey, 2007 (percent rabies positive in parentheses).

	Number Tested	Rabies Positive
Raccoons	349	163 (46.7%)
Skunks	88	28 (31.8%)
Foxes	35	8 (22.9%)
Coyotes	6	1 (16.7%)
Other[a]	2,920	84 (2.9%)
Total	3,398	284 (8.4%)

[a] Other animals included: bats (54 rabid), beavers (1 rabid), cats (18 rabid), cows (1 rabid), deer (1 rabid), dogs (1 rabid), goats (1 rabid), horses (2 rabid), and woodchucks (5 rabid).

New York State Department of Health's Rabies Laboratory at the Wadsworth Center.--The WC analyzes animal serum samples for rabies virus neutralizing antibodies (VNA) to evaluate the efficacy of ORV. New Jersey WS did not submit any samples to the WC in 2007.

ORV PROGRAM 2007– EVALUATION

New Jersey WS did not conduct post-ORV trapping activities in 2007.

SUMMARY

The Cape May County ORV program, although small in scale, maintains its important status as the longest continuously running ORV program in the United States. The CMDH maintains the ORV program due to its proven long term success and continued public support.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
NEW YORK 2007

BACKGROUND

Rabies remains one of the most important zoonoses in the United States. In the past decade, wildlife rabies cases have reached historically high levels with a subsequent increase in human rabies post-exposure prophylaxis. An outbreak that began in the late 1970s, in the mid-Atlantic states, has been attributed to the translocation of infected raccoons (*Procyon lotor*) from Florida for use by various hunting clubs. This event is thought to have marked the beginning of a raccoon rabies outbreak that aggressively spread throughout the mid-Atlantic and northeastern United States, reaching New York in 1990. The raccoon variant of the rabies virus quickly spread and now is present throughout most of the state. In 1994, the New York State Department of Health (NYSDOH) began experimenting with the use of oral rabies vaccination (ORV) in an enzootic area of the Capital Region and was able to demonstrate a decrease in the number of rabid raccoons. This research led to the use of ORV as a rabies control technique in New York State, where 4 distinct ORV programs exist today.

Champlain Valley.--In 1995, after raccoon rabies made a sudden leap of 70 km from southern Essex County in the Adirondacks to mid-Clinton County, the NYSDOH initiated a point-source control plan involving the use of ORV baits. This was followed by the establishment of a Champlain Valley (CV) ORV zone to prevent further northward spread of raccoon rabies up the Lake Champlain valley into Quebec, Canada. In 1998, the NYSDOH switched from a biannual spring and fall baiting program to an annual program with baiting taking place in August. The CV ORV zone was moved south into the enzootic area of Essex County (Figure 1) following the successful elimination of raccoon rabies in Clinton County (last case of raccoon variant rabies was in September 1997). Wildlife Services (WS) began cooperating in the CV ORV program in 1999 by providing financial and operational support. In July 2007, rabies was documented in Quebec, Canada, 3 km (1.8 mi) from the border with Clinton County (Figure 1). The case was most likely a result of the rabies outbreak in northern Vermont which included portions of the Champlain Islands (Figure 1 inset) in Lake Champlain (state border of New York and Vermont). In response to this rabies case in Quebec, and the nearby outbreak in Vermont, New York WS initiated an emergency trap-vaccinate-release (TVR) effort in August 2007. Additionally, WS distributed more than 80,000 ORV baits over the northern portions of Clinton and Franklin Counties to tie into the NYSDOH's CV zone and create a continuous ORV zone to protect northeastern New York from potential rabies incursions from Vermont and Quebec.

St. Lawrence Region.--In 1997, raccoon rabies was documented in St. Lawrence County and the following year an epizootic was identified with 138 confirmed rabies cases in terrestrial wildlife (116 raccoons, 22 striped skunks [*Mephitis mephitis*]). In 1998, a St. Lawrence Region (SLR) ORV program was implemented by Cornell University (CU), the Ontario Ministry of Natural Resources (OMNR), and WS to prevent the northward spread of raccoon rabies in New York and ultimately into Ontario, Canada. Wildlife Services has provided financial and operational support to the SLR ORV program since its inception. In July 1999, the first case of raccoon variant rabies was confirmed in Canada, just northwest of Prescott, Ontario. Since that time, the OMNR has implemented rabies control activities including ORV and TVR (Figure 1). The province has been raccoon rabies-free since September 2005. Rabies cases have declined steadily in the northernmost portion of the SLR ORV zone and St. Lawrence County has been terrestrial rabies-free since June 2004, when 2 skunks were confirmed in the hamlet of Heuvelton. Within the SLR ORV zone, Jefferson County still experiences rabies cases; 21 (15 raccoons and 6 skunks) in 2006 and 16 (8 raccoons, 6 skunks, and 2 gray foxes [*Urocyon cinereoargenteus*]) in 2007. The final documented case of 2007 occurred on Wellesley Island, New York (within the St. Lawrence River) threatening to re-infect Ontario, Canada.

Long Island.--In August 2004, the NYSDOH confirmed raccoon rabies for the first time in Nassau County (Figure 1). By year's end, 10 rabid raccoons had been confirmed in the county. In response to this outbreak an emergency rabies surveillance and control program was initiated by the NYSDOH Zoonoses Program, WS, and the Nassau County Department of Health. High raccoon densities in conjunction with an urban environment make implementing the Long Island (LI) ORV program challenging. Bait distribution and surveillance trapping efforts are also hindered by high human populations. Rabies continued to spread across the northern portion of Nassau County during 2006. On 16 March 2006 Suffolk County became the 61st of 62 counties in New York State to confirm raccoon rabies and by year's end a total of 5 cases were documented in Suffolk County. In 2007, 12

additional cases were documented in Suffolk County. Also in 2007, CU assumed rabies management responsibilities on Long Island, with NYSDOH and WS providing cooperative support.

Western New York.--The OMNR has maintained a TVR zone on the Niagara peninsula of Ontario since 1994 (Figure 1). In 1995, 138 rabid raccoons were confirmed in Niagara County, New York. In response to the outbreak and in an effort to prevent the westward spread of raccoon rabies into Ontario, the New York State Department of Agriculture and Markets (NYSDAM), Niagara County, and the OMNR funded an ORV program. In 1996, baiting began in Chautauqua County to initially prevent the spread of raccoon rabies into Erie County, Pennsylvania. The NYSDAM and Chautauqua County funded this program and CU coordinated bait distribution activities. In the following years, the rabies epizootic continued in Erie County, New York (border county between Niagara and Chautauqua). In 2002, the NYSDAM, the OMNR, and WS began baiting Buffalo, New York (Erie County) using helicopters and bait stations. This collective Western New York (WNY) ORV zone has been tied to larger, national efforts to create an immune barrier from Lake Erie to the Gulf of Mexico.

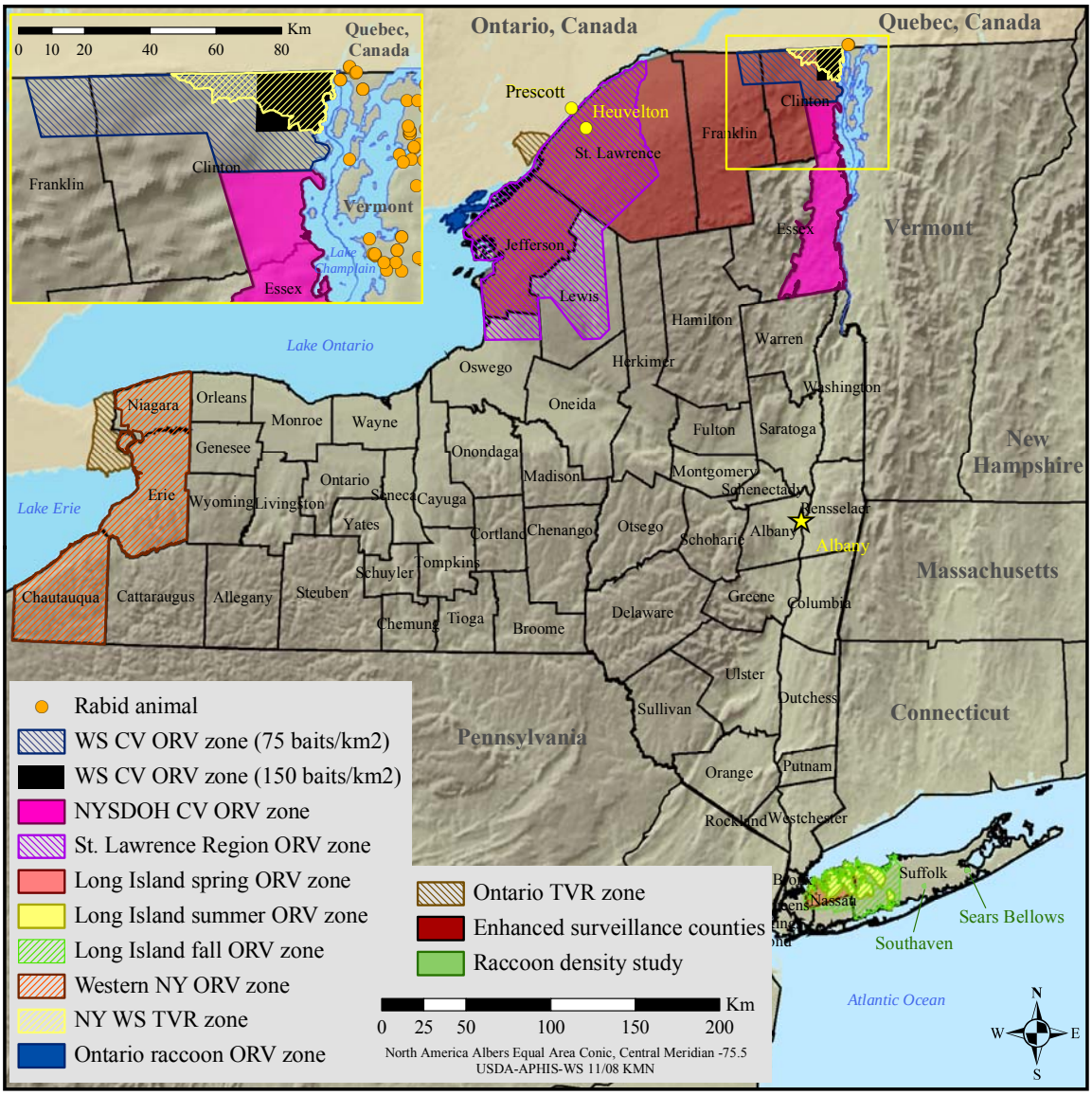

Figure 1. Wildlife Services cooperative rabies management program activities in New York, 2007.

ORV PROGRAM 2007

Bait Distribution

For the tenth consecutive year, WS participated in bait distribution efforts in New York. Since its involvement began in 1998, WS has cooperated to distribute 12,085,563 ORV baits in New York. In 2007, 1,563,046 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 27,788 km^2 (10,729 mi^2) (Figure 1).

Champlain Valley.--From 7-9 August, WS distributed 81,445 fishmeal-coated sachet (CS) baits over 1,426.8 km^2 (550.9 mi^2) in Clinton and Franklin Counties. Most of this zone (1,153 km^2) was baited at 75 baits/km^2, while the northeastern-most part of Clinton County (274 km^2) was double-baited at 150 baits/km^2. All baits were distributed aerially using fixed wing aircraft provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA). In addition to these baits, the NYSDOH used helicopters provided by the New York State Police Aviation Unit (NYSPAU) to distribute 177,840 fishmeal polymer (FMP) baits in Essex and southern Clinton Counties from 20-29 August. The NYSDOH also distributed 3,600 FMP baits during that time via ground operations (hand baiting).

St. Lawrence Region.--From 10-14 August, WS cooperated with CU to distribute 559,085 ORV baits over 16,943.6 km^2 (6,542.1 mi^2) in Jefferson, Lewis, Oswego, and St. Lawrence Counties; 543,605 of those baits were CS's distributed by fixed wing aircraft provided by Dynamic Aviation. Ground bait distribution included 15,480 FMP baits.

Long Island.--During 3 separate baiting efforts in 2007, a total of 393,280 FMP baits were distributed over 1,326.2 km^2 (512.1 mi^2) of Long Island. From 1 April-30 June, CU used bait stations to distribute 29,910 FMP baits in Nassau and Suffolk Counties. In July, CU coordinated bait distribution activities with county and local government agencies and community volunteers. From 23-27 July, 18,703 FMP baits were distributed by hand and 63,902 were distributed by helicopter in Suffolk County. July helicopter services were provided by the NYSPAU. From 5-30 September, 280,765 FMP baits were distributed in Nassau and Suffolk Counties: 137,020 via helicopter; 111,345 via hand baiting; and 32,400 via bait stations. September helicopter services were provided by HeloAir, Inc. (Richmond, Virginia, USA).

Western New York.--From 12-14 August, WS cooperated with CU to distribute 351,396 ORV baits over 5,889.2 km^2 (2,273.9 mi^2) in Cattaraugus, Chautauqua, Erie, Niagara, and Wyoming Counties; 248,076 CS baits were distributed by fixed wing aircraft provided by Dynamic Aviation, while 94,680 FMP baits were distributed by NYSPAU helicopters. Ground bait distribution included 8,640 FMP baits.

Enhanced Surveillance

In 2007, WS continued enhanced rabies surveillance in the northern part of the state by collecting 76 samples in 4 counties (Figure 1) from road killed, abnormally behaving, and nuisance animals submitted by local animal control personnel. Animals included: 57 raccoons, 13 striped skunks, 3 red foxes (*Vulpes vulpes*), 1 coyote (*Canis latrans*), 1 fisher (*Martes pennanti*), and 1 woodchuck (*Marmota monax*) (Table 1). Three road killed animals were not submitted for testing, as their skulls were too badly crushed to collect a viable sample. One of the 73 animals (1.4%) tested was confirmed rabid by the NYSDOH Rabies Laboratory at the Wadsworth Center (WC).

St. Lawrence and Champlain Valley Region Road Kill Surveys.--Each summer since 2005, WS has conducted a road kill survey to enhance rabies surveillance and better define the prevalence and distribution of rabies in the St. Lawrence Region. In 2007, the survey was conducted from June-July and expanded into the Champlain Valley Region. The survey included major roadways throughout the bait zone in Clinton, Franklin, Jefferson, and St. Lawrence Counties. Over the course of a 5-week period, 18,610 km (11,564 mi) of roads were surveyed, resulting in 49 samples (35 raccoons, 9 skunks, 3 red foxes, 1 coyote, and 1 fisher) (see above and Table 1). Forty-seven samples tested negative for rabies and 2 were indeterminate due to poor brain samples.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most

frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories. Currently, WS is not planning training or implementation of the dRIT because the WC is meeting enhanced surveillance testing needs.

Table 1. Animals collected by Wildlife Services to enhance rabies surveillance in northern New York, 2007 (rabies positives in parentheses).

County	Raccoon	Skunk	Red fox	Coyote	Fisher	Woodchuck	Total
Clinton	12	8[a]	1		1		22
Franklin	2	1					3
Jefferson	7[a] (1)	2	1				10 (1)
St. Lawrence	36[a]	2	1	1		1	41
Total	57 (1)	13	3	1	1	1	76 (1)

[a] One animal was not submitted due to a badly crushed skull (no viable sample for testing).

Coordinated TVR

In July 2007, rabies was documented in Quebec, Canada, 3 km from the border with Clinton County, New York (Figure 1). At this time rabies was continuing to spread westward in neighboring Vermont, reaching the eastern shoreline of Lake Champlain. In response to the threat of rabies continuing to spread south from Quebec and west from Vermont, an emergency TVR effort was initiated in the northeast portion of Clinton County (Figure 1).

From 6-17 August, 8 WS personnel from New York, Tennessee, and West Virginia used cage traps to capture 508 unique raccoons and 61 skunks. All skunks and 20 rabies suspect (sick, aggressive, strange acting) raccoons were euthanized and submitted to the WC for rabies testing; all animals tested negative. In addition, 1 raccoon was found dead in a cage trap and submitted; it also tested negative for rabies. The remaining 487 raccoons were hand vaccinated with 1 ml of Imrab3® rabies vaccine (Merial Limited) and released. The first 140 of those raccoons were immobilized and processed as normal (blood samples collected) to gather background serology. Raccoons captured after those were vaccinated, ear tagged, and released without further processing. Additionally, 26 feral/free-ranging cats (*Felis catus*), 2 fishers, and 1 red fox were hand vaccinated and released without processing.

Coordinated TVR was repeated from 1 October to 2 November, using 3 WS trappers from New York, and an additional 135 raccoons were vaccinated, tagged, and released without further processing. This included 1 raccoon that had been vaccinated in August as well. In addition, 8 skunks, 7 cats, and 2 fishers were vaccinated and released. Seven more skunks were euthanized to enhance surveillance; they all tested negative for rabies. One raccoon was vaccinated and released and 9 days later found dead in a corn field. It was submitted for rabies testing, but the results were indeterminate due to poor sample condition.

Animals trapped during post-ORV monitoring in 2007 were also hand vaccinated and released (see Post-ORV Monitoring section). By year's end, 1,025 animals (unique to a given sampling period) were trapped, vaccinated, and released (Table 2).

Table 2. Animals trapped, vaccinated, and released by Wildlife Services in New York, 2007.

	Clinton Co. TVR (August)	Clinton Co. TVR (September)	Clinton Co. TVR (October)	Essex Co. TVR (September)	Jefferson Co. TVR (Sep./Oct.)	Total
Raccoons	487	155	135	75	115	967
Cats	26	1	7	4		38
Skunks			8	6	1	15
Fishers	2		2			4
Red foxes	1					1
Total	516	156	152	85	116	1,025

All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Population Monitoring

For the third consecutive year in 2007, WS conducted 2 raccoon density studies in Suffolk County on Long Island (Figure 1). The National Rabies Management Program standard protocol (50 cage traps set on a target study area of 3 km^2 [1.2 mi^2] for 10 consecutive nights) was used. The studies will help determine ORV bait densities for central and eastern Suffolk County, should raccoon rabies spread and reach the population there. Both study areas were within forested county parks with campgrounds near a suburban interface. Sears Bellows County Park (eastern Suffolk County) is a 693-acre park within the Long Island Pine Barrens, while Southaven County Park (central Suffolk County) is a 1,323-acre pine-oak forested park. The index to raccoon density has remained constant within each study area over the 3-year period (Table 3). Blood samples were collected and sent to the WC for rabies virus neutralizing antibody (VNA) testing. All but 1 raccoon were immobilized, processed and released. One raccoon was euthanized because is displayed abnormal behavior in the trap; it tested negative for rabies.

Table 3. Index to raccoon densities in Suffolk County (Long Island), New York, 2005-2007.

	Sears Bellows County Park			Southaven County Park		
	2005	2006	2007	2005	2006	2007
Trap nights	500	500	500	500	500	500
Unique raccoons	24	27	32	75	67	74
Recaptured raccoons	10	16	19	32	27	31
Total raccoons	34	43	51	107	94	10
Trap success[a]	4.8%	5.4%	6.4%	15.0%	13.4%	14.8%
Non-target captures[b]	39	13	24[c]	24	9	15[c]
Area (km^2)	3.39	3.39	3.39	2.94	2.94	2.94
Raccoon density index[c]	7.1	7.9	9.1	25.5	22.8	24.8

[a] Uunique raccoons/trap nights x 100.
[b] Includes non-target captures and traps that were otherwise unavailable to capture a raccoon (sprung, stolen, etc.).
[c] Unique raccoons/km^2.

Post-ORV Monitoring

Champlain Valley, Clinton County.--Post-ORV sampling for WS' portion of the CV ORV zone in Clinton County was conducted from 4-28 September. Using cage traps, 166 unique raccoons were trapped, immobilized, and processed (blood and tooth samples collected to evaluate post-ORV efficacy). Imrab3® was administered to 155 of them, while the remaining 11 raccoons were previously captured in September and vaccinated. All but 1 raccoon (of the 166) was released. One was euthanized because it displayed uncontrollable head movements; it tested negative for rabies. Nine skunks were immobilized, processed and euthanized to enhance surveillance; they all tested negative for rabies. In addition, 1 cat was opportunistically vaccinated and released during post-ORV trapping in Clinton County.

Champlain Valley, Essex County.--Wildlife Services provided post-ORV sampling assistance for the NYSDOH's portion of the CV ORV zone in Essex County from 17-22 September. Using cage traps, WS trapped, immobilized, and processed 77 unique raccoons. All but 2 were given 1 ml of Imrab3® and released. One raccoon was euthanized because it was displaying abnormal behavior in the trap and 1 raccoon died under anesthesia. Neither animal was submitted for rabies testing. Six skunks and 4 cats were opportunistically vaccinated and released by WS during post-ORV trapping in Essex County.

St. Lawrence Region.--Post-ORV sampling for the SLR ORV zone was conducted from 24 September to 18 October. Cage traps were used to capture 117 unique raccoons in Jefferson County. All but 2 raccoons were immobilized, processed, vaccinated and released. One raccoon was euthanized due to a severe stomach wound and 1 raccoon was found dead in a trap. Neither animal was submitted for rabies testing. In addition, 4 unique skunks

were trapped; 3 of them immobilized, processed, and euthanized to enhance surveillance (all negative for rabies) and 1 was opportunistically vaccinated and released. In addition, blood was collected from 2 raccoons euthanized by a local cooperator, bringing the total number of raccoon serum samples to 119 during the SLR post-ORV evaluation period.

Long Island and Western New York.--Wildlife Services did not conduct post-ORV evaluation on Long Island or in Western New York in 2007.

Non-target Captures

Non-target animals captured and released (without processing or vaccination) by WS in 2007 included: 44 opossums (*Didelphis virginiana*), 36 domestic/feral cats, 13 striped skunks, 10 gray squirrels (*Sciurus carolinensis*), 8 red squirrels (*Tamiasciurus hudsonicus*), 7 snowshoe hares (*Lepus americanus*), 5 Eastern cottontails (*Sylvilagus floridanus*), 5 porcupines (*Erethizon dorsatum*), 5 woodchucks (*Marmota monax*), 3 muskrats (*Ondatra zibethicus*), 2 Norway rats (*Rattus rattus*), 1 red fox, and 1 downy woodpecker (*Picoides pubescens*).

In addition, 3 red squirrels and 1 ruffed grouse (*Bonasa umbellus*) were found dead in cage traps.

Rabies Laboratory Cooperation

New York WS cooperates with the NYSDOH Rabies Laboratory at the WC in support of the ORV programs throughout New York. The WC cooperates in rabies surveillance efforts by testing brainstems for the rabies virus. They also collaborate in ORV evaluation efforts by testing wildlife serum for rabies VNA.

Rabies Virus Testing.--The WC tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure, usually submitted by Animal Control Officers, Conservation Officers, county health departments, veterinarians, and the public) and enhanced surveillance (specimens not involved in an exposure and usually submitted by WS). The WC received 9,730 animals for rabies testing in 2007, representing a 9.0% increase from the number of samples received statewide in 2006. In 2007, animals were submitted to the WC from 57 of 62 counties throughout the state, including all 15 ORV counties: Cattaraugus, Chautauqua, Clinton, Erie, Essex, Franklin, Jefferson, Lewis, Nassau, Niagara, Oneida, Oswego, St. Lawrence, Suffolk, and Wyoming. The New York City Department of Health and Mental Hygiene (NYCDH) examines rabies specimens from the 5 New York City counties: Bronx, Kings, New York, Queens (ORV county), and Richmond. The WC confirmed 515 cases of rabies statewide in 2007; of these, 13% were raccoons from counties treated with ORV (Table 4). The NYCDH confirmed 44 cases of rabies (out of 789 specimens received); none of these data are included in Table 2. The WC and the NYCDH confirmed a total of 559 cases of rabies from New York State in 2007.

Raccoons, skunks, and foxes are of primary interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of primary interest to public health agencies. This explains why 76.9% of the animals submitted to the WC for rabies testing in New York in 2007 are reported by WS as "other." For a detailed listing of current and historical rabies data from New York State please visit: http://www.wadsworth.org/rabies/

Table 4. Rabies positives/animals submitted for rabies testing to the New York State Department of Health's Rabies Laboratory at the Wadsworth Center in New York, 2007.

	Statewide[a]	Champlain Valley[b] ORV counties	St. Lawrence Region[b] ORV counties	Long Island[b] ORV counties	Western New York[b] ORV counties
Raccoons	282/1819	0/89	12/111	16/1039	39/172
Skunks	75/319	0/91	10/41	0/0	7/33
Foxes	25/107	1/5	4/16	0/1	2/14
Other[c]	133/7482	0/168	9/1094	3/276	27/1201
Total	515/9730	1/353	35/1262	19/1316	75/1420

[a] 53 submissions including 3 positive raccoons were from outside of New York State.
[b] Champlain Valley: Clinton, Essex and Franklin Counties; St. Lawrence Region: Jefferson, Lewis, Oneida, Oswego, and St. Lawrence Counties; Long Island: Nassau and Suffolk Counties (Queens County is not represented in this table because the New York City Department of Health and Mental Hygiene tests rabies specimens from Queens County); Western New York: Cattaraugus, Chautauqua, Erie, Niagara, and Wyoming Counties.
c Other animals included: bats, beavers, cats, cows, coyotes, deer, dogs, horses, lagomorphs, mules, rodents, woodchucks, and other domestic and wild animals not listed.

Rabies Virus Neutralizing Antibody Testing.--The WC also analyzed 603 blood serum samples for rabies VNA submitted by New York WS in 2007. This represented an increase of 106% over the 293 samples submitted in 2006. New York WS anticipates approximately 600 serum sample submissions to this laboratory in 2008.

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, WS live-trapped 1,131 unique raccoons; blood serum samples were collected from 526 of them (Table 5). During August TVR in Clinton County, blood was drawn from the first 140 raccoons to gather background serology information in this ORV naïve area. Aerial baiting did occur during the TVR effort and the 1 raccoon that demonstrated a positive rabies antibody response was captured 1 day post-ORV.

During post-ORV trapping in Clinton County, serum samples were collected from raccoons in both the standard bait (75 baits/km^2) and double bait (150 baits/km^2) density zones. In the standard bait zone 6 raccoons (7.5%) had detectable rabies VNA, and 4 of 6 (66.7%) had a record of hand vaccination in August (Table 5). None of those 4 had serum collected in August. In the double bait zone 15 raccoons (18.1%) had detectable rabies VNA, and 4 of 15 (26.7%) had a record of hand vaccination in August. One of those 4 had serum collected in August and it did not have antibodies.

During post-ORV evaluation in the SLR ORV zone, sera were collected from 119 raccoons; 25.2% demonstrated a positive rabies antibody response (up from 17.9% in 2006). Sera were collected from 104 raccoons during density studies in Suffolk County. These study areas are ORV naïve and 4.8% of the samples had detectable rabies VNA (Table 5). As the lead agency on the NYSDOH's CV ORV zone (Essex and southern Clinton Counties), the health department reports those serologic, biomarker, and age data.

In addition to raccoons, sera were collected from 77 skunks: 58 during Clinton County August TVR (0-1 week post-ORV); 16 during Clinton County post-ORV (4-7 weeks post-ORV); and 3 during SLR post-ORV (7-10 weeks post-ORV). None of the 77 skunks had detectable rabies VNA.

Table 5. Serology results of raccoon biological samples collected by Wildlife Services during cooperative rabies management trapping activities in New York, 2007.

	Clinton Co. TVR[a] (August)[b]	Clinton Co. Post-ORV (75 baits/km^2)	Clinton Co. Post-ORV (150 baits/km^2)	St. Lawrence Region Post-ORV	Suffolk Co. Density Studies[c]
Sample collection timeframe	6-16 Aug.	4-27 Sep.	4-27 Sep.	24 Sep.-18 Oct.	22 Oct.-1 Nov.
Weeks post-ORV	0-1	4-7	4-7	7-10	n/a
ORV bait type @ bait density	CS @ 75 and 150 baits/km^2	CS @ 75 baits/km^2	CS @ 150 baits/km^2	CS @ 70 baits/km^2	n/a
Unique raccoons	508	81	85	119	106
			Serology		
Testable blood samples	140	80	83	119	104
Positive rabies antibody response (≥0.05 IU)	1 (0.7%)	6 (7.5%)[d]	15 (18.1%)[d]	30 (25.2%)	5 (4.8%)

[a] TVR=trap-vaccinate-release; ORV=oral rabies vaccination; CS=coated sachet.
[b] This area was ORV naïve until baiting occurred during the TVR effort.
[c] These study areas are ORV naïve (never previously treated with ORV).
[d] Four raccoons were hand vaccinated prior to release in August.

In 2007, teeth from 525 raccoons, 88 skunks, 2 red foxes, 1 coyote, and 1 fisher were sent to Matson's Laboratory LLC (Milltown, Montana, USA). These teeth were collected from enhanced surveillance, coordinated TVR, post-bait surveillance in the SLR and CV zones, as well as the population studies in Suffolk County. All teeth collected in 2007 will be analyzed for age and biomarker, but were not available at the time of this report.

SUMMARY

In 2007, New York WS conducted its tenth year of rabies control activities in the SLR ORV zone and provided financial support for the third and fourth years in the WNY and LI ORV zones, respectively. This was the first year of WS baiting in the CV ORV zone and activities in 2007 focused on this area. By baiting the northern portion of Clinton County, WS was able to tie into the long-standing NYSDOH ORV zone in southern Clinton and Essex Counties which created one contiguous zone approximately 135 km (81 mi) in length.

Over 1.5 million baits were distributed across the 4 New York ORV zones to stop the spread of raccoon rabies. Enhanced surveillance led to the collection of 76 animals and 1 tested positive for rabies. During TVR efforts 1,025 animals were trapped, vaccinated, and released and serum samples were collected from 603 animals to gather background serology in ORV naïve areas and evaluate the efficacy of ORV in areas that had been treated.

In 2008, WS will continue to distribute ORV baits, enhance rabies surveillance, conduct TVR, and complete post-bait monitoring and evaluation in the SLR and CV ORV zones. In addition, baiting will take place in the WNY ORV zone and the raccoon density studies in Suffolk County will be repeated. The CV, SLR, and WNY zones are part of a larger northeastern rabies control effort that includes Vermont, New Hampshire, Maine and Ontario, Quebec, and New Brunswick, Canada. The LI ORV program remains critical to limiting raccoon rabies on Long Island. Future ORV baiting strategies in New York will continue to be tied to national and international planning efforts to contain the raccoon variant of the rabies virus and explore strategies to eliminate the disease from North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
NORTH CAROLINA 2007

BACKGROUND

Nettles et al. (1979) reported rabies positive raccoons (*Procyon lotor*) being translocated into North Carolina from Florida by raccoon hunting clubs. It was not until 1991, however, that significant numbers of rabid raccoons from the wild were being reported. The first counties experiencing the increase occurred in the northeastern portion of the state as the mid-Atlantic epizootic crossed into North Carolina. By 1992 it was evident that a second distinct epizootic front crossed into North Carolina in the southeastern portion of the state, with several cases showing up in Brunswick and Bladen Counties. In 1993, the epizootic had clearly moved into the southern piedmont and coastal plains. During 1995, a third distinct epizootic outbreak occurred when the disease spread into the northwestern corner of the state, from southwestern Virginia. North Carolina has thus become the meeting point for 3 waves of the raccoon variant of the rabies virus. Presently, 96 of 100 counties have reported cases of raccoon rabies. (Macon was erroneously reported as rabies positive in the 2006 report.) The remaining 4 counties not reporting cases are in the western portion of the state (Figure 1). They are all in rural areas and do not have active animal control agencies, likely contributing to the fact that they have not reported any cases of raccoon rabies. In 2005, rabies positive cases were reported in Tennessee just west of the North Carolina border along the Nolichucky River basin (Figure 1). These cases, and the increasing number of positives from North Carolina border counties (especially Yancey), confirmed that the epizootic was breaching the Appalachian Ridge (AR) oral rabies vaccination (ORV) zone along the major river valleys. In an attempt to control this breach, Wildlife Services (WS) decided to extend the AR zone into North Carolina in 2005, along both the Nolichucky and French Broad River basins. In 2006, the ORV zone was widened slightly into Jackson and Swain Counties. The 2007 ORV zone was a replicate of 2006 (Figure 1).

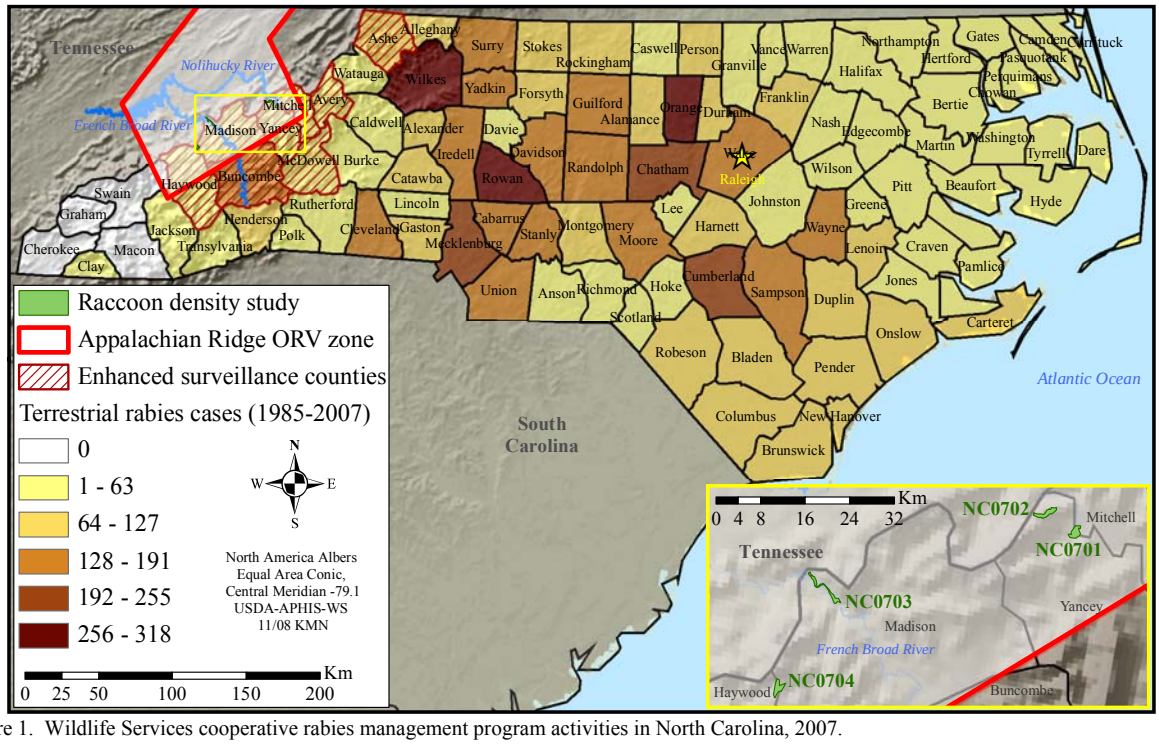

Figure 1. Wildlife Services cooperative rabies management program activities in North Carolina, 2007.

ORV PROGRAM 2007

Bait Distribution

The 2007 season marked the third year WS participated in bait distribution efforts in North Carolina; 184,029 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were

distributed over 2,917 km2 (1,126 mi2). The ORV zone included portions of Buncombe, Haywood, Jackson, Madison, Mitchell, Swain, and Yancey Counties. During 5-11 October bait distribution efforts, 181,869 fishmeal coated sachets (CS) were distributed by fixed-wing aircraft (provided by Dynamic Aviation Group Inc. [Bridgewater, Virginia, USA]), while 2,160 fishmeal polymer (FMP) baits were distributed by hand (in urban areas of Madison, Mitchell, and Yancey Counties). Since its program inception in 2005, WS has distributed 504,818 ORV baits in North Carolina.

Enhanced Surveillance

North Carolina WS initiated an enhanced rabies surveillance program in 2004 to better document the extent of rabies cases near the western front of the disease (along the North Carolina-Tennessee border). All of the Tennessee border counties are along the AR, thought to pose a potential natural barrier to the westward spread of raccoon rabies. Historically, only 4 of 10 border counties had active animal control agencies and many used regional health departments rather than county level departments. The lack of animal control personnel, coupled with the rural nature of the area, contributed to sporadic rabies surveillance efforts as compared to the rest of the state.

An increase in rabid animals in Yancey County in 2005 (16 animals compared to 1 case of rabies in 2004) prompted the county to add a full time animal control person to their staff. In addition, WS made a half-time position (filled in 2004 to enhance rabies surveillance) a full-time position in 2005. This wildlife specialist worked with local authorities to collect 128 specimens in 2007: 111 raccoons, 5 striped skunks (*Mephitis mephitis*), 4 gray foxes (*Urocyon cinereoargenteus*), 4 red foxes (*Vulpes vulpes*), 3 coyotes (*Canis latrans*), and 1 bobcat (*Lynx rufus*). Cooperators were able to freeze carcasses of road killed and suspect rabid animals, while completing a data sheet containing basic biological information about the animal.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Wildlife Services personnel prepared the carcasses (head/brainstem removal) and tested 127 samples (1 skunk brainstem was not testable) using the dRIT, confirming 50 rabid animals: 47 raccoons, 2 skunks, and 1 bobcat. All positives and 10% of negative samples were sent to the Centers for Disease Control and Prevention (CDC) for confirmation and variant typing. The CDC (using the dFA test) had agreement with all of the negative samples but reversed 3 of the WS dRIT positives (2 raccoons and 1 bobcat). All remaining positives (n=47) were confirmed as the raccoon variant of rabies. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in North Carolina.

Population Monitoring

In 2007, WS conducted 4 raccoon density studies using the National Rabies Management Program (NRMP) "standard" and "low" protocols. The standard protocol involves 50 cage traps set on a target study area of 3 km² (1.2 mi^2) for 10 consecutive nights. The low protocol involves 5 consecutive nights of trapping instead of 10 and was established in 2005 to eliminate futile effort in areas where raccoon densities are believed to be ≤ 1 raccoon/km^2; if at the end of Day 4, ≤ 2 unique raccoons have been captured, traps are checked and pulled on Day 5.

Two studies were conducted in Yancey County (NC0701 and NC0702), 1 in Madison County (NC0703), and 1 covered parts of Madison and Haywood Counties (NC0704) (Figure 1). The studies were paired with a high elevation (>1,000 m) and low elevation (≤700 m) study area (Table 1). Study area NC0701 only had 474 targeted trap nights (as opposed to the standard of 500); only 24 traps were set on Day 0 due to severe thunderstorms. During the 4 studies, 81 unique raccoons were captured, immobilized, and released; blood and tooth samples were collected from all. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 1. Index to raccoon densities in Yancey, Madison, and Madison/Haywood Counties in North Carolina, 2007.

	Yancey (NC0701)	Yancey (NC0702)	Madison (NC0703)	Madison & Haywood (NC0704)
Time of study	18-27 Jul	18-27 Jul	18-27 July	18-23 July
Weeks post-ORV	48-49	48-49	48-49	48-49
Macrohabitat	Agriculture	Forested	Agriculture	Forested
Average elevation (m)	700	1,193	428	1,229
Target trap nights	474[a]	500	500	250
Unique raccoons	26	8	45	2
Recaptured raccoons	14	2	20	0
Non-target captures[b]	33	44	70	38
Area (km^2)	3.00	3.11	3.05	3.00
Raccoon density index[c]	8.7	2.6	14.8	0.7

[a] Only had 474 targeted trap nights (as opposed to the standard of 500); unable to set all 50 traps on Day 0 due to severe thunderstorms.
[b] Includes traps that were sprung but with no animal captured.
[c] Unique raccoons/km^2.

Post-ORV Monitoring

Between 14-20 and 27-30 November, WS conducted post-ORV trapping activities in Buncombe, Haywood, Madison, Mitchell, and Yancey Counties. Blood serum samples from 120 raccoons were collected to measure the presence of rabies virus neutralizing antibody (VNA) response in this ORV zone. Tooth samples from 110 of those raccoons were also collected and submitted for age analysis. All raccoons were immobilized, processed and released.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 111 opossums (*Didelphis virginiana*), 13 domestic cats (*Felis catus*), 4 Eastern cottontails (*Sylvilagus floridanus*), 4 gray squirrels (*Sciurus carolinensis*), 3 domestic dogs (*Canis lupus familiaris*), 2 striped skunks, 1 Eastern box turtle (*Terrapene carolina*), and 1 wood duck (*Aix sponsa*).

Rabies Laboratory Cooperation

Wildlife Services' ORV program in North Carolina cooperates with the North Carolina Department of Health and Human Services, State Health Laboratory (SHL) and the CDC.

North Carolina Department of Health and Human Services, State Health Laboratory.--The SHL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure to the rabies virus). The SHL received 4,134 samples for rabies virus testing in 2007 and confirmed 474 positives (Table 2). In recent years, the SHL has conducted rabies virus typing on all non-raccoon terrestrial wildlife samples; they have all been confirmed as raccoon variant.

Raccoons, foxes, skunks, coyotes, and bobcats are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 78.9% of the animals tested for rabies by the SHL in 2007 are reported by WS as "other." For a full listing of rabid animals in North Carolina by county and species from 1990 to the present please visit: http://www.epi.state.nc.us/epi/rabies/state.html

Table 2. Animals submitted and tested for rabies by the North Carolina Department of Health and Human Services, State Health Laboratory in North Carolina, 2007.

	Submissions	Rabies Positive
Raccoons	620	245 (39.5%)
Foxes	109	58 (53.2%)
Skunks	137	98 (71.5%)
Coyotes	5	3 (60.0%)
Bobcats	0	0
Other[a]	3,263	70 (2.1%)
Total	4,134	474 (11.5%)

[a] Other animals included: alpaca, bat, bear, beaver, buffalo, cat, coatimundi, cow, deer, degu, dog, donkey, equine, ferret, gerbil, goat, guinea pig, hamster, kangaroo, human, llama, leopard, mink, mouse, muskrat, nutria, ocelot, opossum, otter, pig, prairie dog, rabbit, rat, rodent, sheep, squirrel, vole, weasel, wolf, wolf-dog hybrid, and woodchuck (groundhog).

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA. North Carolina WS submitted 120 blood serum samples for rabies VNA analysis to the CDC in 2007, about the same as in 2006 (n=121). The North Carolina ORV program anticipates similar numbers of serum sample submissions to the CDC in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In November, 5-7 weeks post-ORV bait distribution, WS live-trapped 120 raccoons with 30 (25.0%) showing presence of rabies VNA. Tooth samples were collected from 110 raccoons and were sent to Matson's Laboratory LLC (Milltown, Montana, USA) for age analysis, but not tetracycline because CS baits were distributed. Tooth results were pending at the time of this report.

SUMMARY

During 2007, WS completed its fourth year of cooperative participation in rabies management in North Carolina, and its third year conducting ORV bait distribution activities. Other activities in 2007 included enhanced surveillance of raccoon rabies and post-ORV monitoring and evaluation in western North Carolina along the Tennessee border. Future ORV baiting strategies in North Carolina will continue to be directed towards halting the spread of raccoon rabies into the western U.S. The North Carolina ORV zone will continue to be tied to national and international planning efforts to contain the disease and explore strategies to eliminate the raccoon variant of the rabies virus from North America.

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WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
OHIO 2007

BACKGROUND

The raccoon (*Procyon lotor*) variant of the rabies virus was first documented in Ohio in 1996 (Mahoning County). Rabies cases continued to escalate and in April 1997 an epizootic of raccoon rabies was identified in northeastern Ohio, with 62 positive cases by year's end. Due to this epizootic and a peak in public interest, an oral rabies vaccination (ORV) program was initiated in Ohio in an attempt to prevent the further westward spread of raccoon rabies. The original ORV bait zone included Trumbull, Mahoning, and Columbiana Counties, and encompassed 1,780 km^2 (688 mi^2). With increased surveillance, raccoon rabies cases were confirmed outside the ORV zone. Subsequently, in the fall 1999, the ORV zone more than tripled in size to include Ashtabula, Trumbull, Mahoning, Columbiana, Carroll, and Jefferson Counties, encompassing 6,497 km^2 (2,509 mi^2). By 2004, the ORV zone had nearly doubled again to 11,845 km^2 (4,573 mi^2) and included Ashtabula, Trumbull, Mahoning, Columbiana, Carroll, Jefferson, Harrison, Belmont, Monroe, and Washington Counties. Despite this long-standing ORV zone, in July 2004, a rabid raccoon (with raccoon variant) was confirmed 10.6 km (6.6 mi) west of the zone in Lake County, marking the western-most case of raccoon rabies in Ohio. This case triggered a contingency action response (that included enhanced rabies surveillance via local raccoon population reduction, trap-vaccinate-release [TVR], and ORV bait distribution) over 2,471 km^2 (954 mi^2) of Cuyahoga, Geauga, Lake, Portage, and Summit Counties. In 2007, Ohio maintained both the contingency action (CA) and the historic Appalachian Ridge (AR) ORV zones (Figure 1), which are part of a larger zone that stretches from Lake Erie to the Appalachian Mountains of Tennessee and North Carolina.

The Ohio Department of Health (ODH) is the lead agency for Ohio's ORV program. Wildlife Services (WS) is an active cooperator, now providing a major source of cooperative funding and federal wildlife management leadership. Additional cooperators include the Ohio Department of Agriculture (ODA), the Ohio Department of Natural Resources (ODNR) Division of Wildlife, the Centers for Disease Control and Prevention (CDC), Ohio State University, Ohio Department of Transportation, and local/county health departments.

ORV PROGRAM 2007

Bait Distribution

Wildlife Services participated in bait distribution efforts in eastern Ohio for the eleventh consecutive year in the AR ORV zone and for the fourth year in the CA ORV zone; 1,123,259 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 10,006 km^2 (3,863 mi^2) in 2007 (Figure 1). Target bait density for the Ohio ORV zones is 75/km^2. Since its program inception in 1997, WS has cooperated to distribute 10,527,959 ORV baits in Ohio.

Contingency Action.--In April 2007, the CA ORV zone in Cuyahoga, Geauga, Lake, Portage, and Summit Counties was baited for the fourth year (initially baited in September 2004). On 24 April, 249,660 ORV baits were distributed over 2,904 km^2 (1,121 mi^2): 121,500 fishmeal coated sachet (CS) baits via fixed-wing aircraft; 95,040 fishmeal polymer (FMP) baits via ground operations (hand baiting); and 33,120 FMP baits via helicopter. Aerial baiting was based out of North Lima, Ohio and fixed-wing aircraft and flight crew were provided by the Ontario Ministry of Natural Resources (OMNR), while helicopters and flight crew were provided by the ODNR. Ground and hand baiting support was provided by WS, the ODH, the ODNR, and county/local health departments. The CA ORV zone was baited again in September 2007 as part of the larger AR ORV zone (see *Appalachian Ridge* below).

Appalachian Ridge.--In 2007, the Ohio portion of the AR ORV zone covered 10,006 km^2 (3,863 mi^2) in 14 counties (Figure 1); 855,599 ORV baits were distributed. From 12-14 August, during aerial baiting out of Port Meadville, Pennsylvania, 1,942 CS baits were distributed via fixed-wing aircraft provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA) in Columbiana, Mahoning, and Trumbull Counties. The actual AR ORV effort was conducted from 31 August-5 September with 629,377 CS baits distributed via fixed-wing aircraft; 171,000 FMP baits via hand baiting; and 53,280 FMP baits via helicopter. Aerial baiting was again based out of North Lima, Ohio and fixed-wing aircraft and flight crew were provided by the OMNR, while helicopters and flight crew were provided by the ODNR. Ground and hand baiting support was provided by WS, the ODH, the ODNR, the ODA, the Ohio National Guard, and county/local health departments.

Contingency Action Supplemental.--From 3-5 October, Ohio WS assisted Lake County General Health District with a supplemental hand baiting effort in response to a cluster of rabies positives in the northwest corner of Lake County. During ground operations, 18,000 FMP baits were distributed over 240 km^2 (93 mi^2) of Lake County.

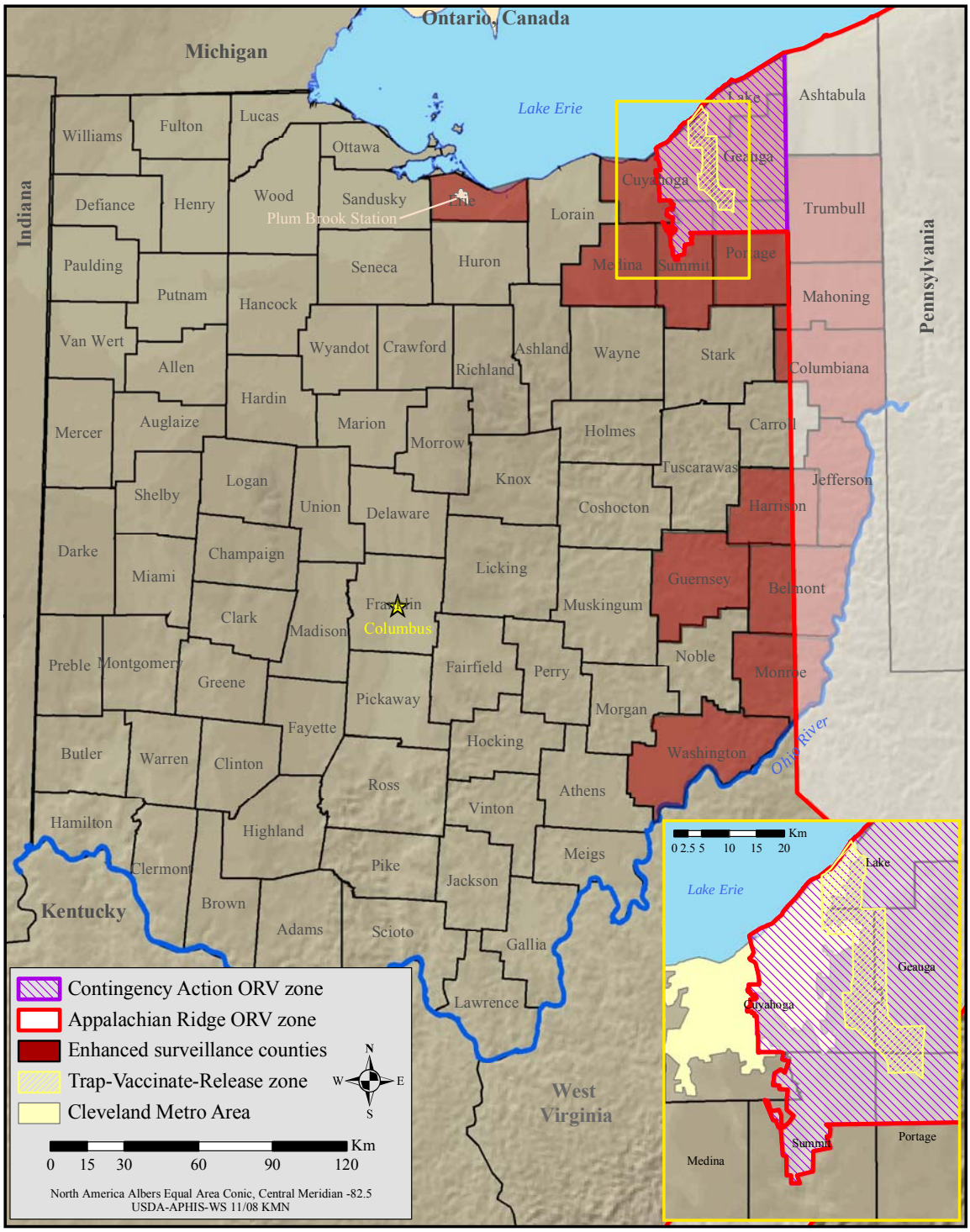

Figure 1. Wildlife Services cooperative rabies management program activities in Ohio, 2007.

Enhanced Surveillance

In 2007, WS enhanced surveillance of raccoon rabies by collecting, submitting, and testing suspect rabid animals from counties in or near the Ohio ORV zones (Figure 1). Wildlife Services collected animals by the following methods: 1) humanely euthanizing (according to the American Veterinary Medical Association's Panel on Euthanasia recommendations) raccoons that had puncture wounds/bite marks, exhibited disorientation, or showed signs of illness during trapping activities; 2) conducting road kill surveillance and collecting mammals in suitable testing condition; 3) obtaining wildlife reported by Ohio residents as displaying rabies-like symptoms; and 4) obtaining wildlife from nuisance wildlife control officers. Wildlife Services also continued to work with state and local health departments to increase the number of enhanced surveillance samples for rabies testing.

As a result of enhanced surveillance efforts throughout Ohio, WS cooperated to collect and submit 921 animals for rabies testing: 826 raccoons, 51 striped skunks (*Mephitis mephitis*), 14 woodchucks (*Marmota monax*), 11 opossums (*Didelphis virginiana*), 7 domestic/feral cats (*Felis catus*), 4 fox squirrels (*Sciurus niger*), 4 red foxes (*Vulpes vulpes*), 3 coyotes (*Canis latrans*), and 1 beaver (*Castor canadensis*). Of those samples, 841 (91%) came from counties in or adjacent to the CA ORV zone.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Ohio WS personnel continued to conduct dRIT testing in 2007, and tested all 921 enhanced surveillance samples for rabies using the dRIT (Table 1). Of these samples, 20 tested positive and 901 were negative. All positives, 10% of all negatives, and all indeterminate samples were sent to the CDC for confirmation and variant typing. The CDC (using the dFA test) had 100% agreement with WS dRIT results and confirmed the 20 positives as raccoon rabies variant. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Ohio.

Table 1. Animals tested for rabies by Wildlife Services using the Direct Rapid Immunohistochemistry Test (dRIT) in or adjacent to ORV counties in Ohio, 2007 (raccoon rabies variant positives in parentheses).

County	Raccoon	Skunk	Red fox	Coyote	Feral cat	Other[a]	Total
Belmont	10						10
Columbiana	8		1			1	10
Cuyahoga	205 (1)	7		2	3	7	224 (1)
Erie	9						9
Geauga	123	7					130
Guernsey	4						3
Harrison	1						1
Jefferson	7						7
Lake	356 (9)	35(9)			2	14	407 (18)
Mahoning	21(1)	1	2		2	1	27 (1)
Medina[b]	11					1	12
Monroe	8						8
Portage	43	1				2	46
Summit	10			1		2	13
Trumbull	5		1			2	8
Washington[b]	5						5
Total	826 (11)	51(9)	4	3	7	30	921 (20)

[a] Other animals included: 1 opossum in Columbiana Co.; 7 woodchucks in Cuyahoga Co.; 6 opossums, 6 woodchucks and 2 fox squirrels in Lake Co.; 1 opossum in Mahoning Co.; 1 opossum in Medina Co.; 1 beaver and 1 woodchuck in Portage Co.; 2 opossums in Summit Co.; 2 fox squirrels in Trumbull Co.

[b] ORV not applied in this county.

Coordinated TVR

In a continuing effort to stop the spread of raccoon rabies in the CA ORV zone, WS conducted a Coordinated TVR effort from 2 April to 20 November 2007 using 2 to 13 trappers. During this time, 1,013 unique raccoons and 3 striped skunks were immobilized, processed and released; 1,007 of those raccoons and 3 striped skunks were hand vaccinated with 1 ml of Imrab3® rabies vaccine (Merial Limited) prior to release. Three feral cats were also trapped, vaccinated, and released. In addition, 445 raccoons and 3 striped skunks were trapped, euthanized and tested to enhance rabies surveillance. One of those raccoons from Cuyahoga County tested positive for rabies using the dRIT and was confirmed as raccoon variant rabies by the CDC (Table 1). In total, blood serum samples were collected from 1,357 raccoons and 2 skunks during this effort, which was conducted 2-29 weeks post-ORV.

Post-ORV Monitoring

Post-ORV sampling for the spring baiting of the CA ORV zone was initiated on 4 June 2007. Cage traps were used to capture 132 unique raccoons over 944 trap nights: 130 raccoons were immobilized, processed and released, while 2 raccoons were euthanized and tested to enhance rabies surveillance; they both tested negative (Table 1). One hundred twenty one raccoons were hand vaccinated during this post-ORV sampling effort.

Post-ORV sampling for Ohio's fall baiting of the AR ORV zone (which included a repeat of the CA ORV zone) was initiated on 9 October 2007. Trapping efforts were concentrated in the CA ORV zone. Cage traps were used to capture 173 unique target animals over 1,490 trap nights: 151 raccoons and 1 striped skunk were immobilized, processed and released, while 20 raccoons and 1 striped skunk were euthanized and tested to enhance rabies surveillance; they all tested negative (Table 1). One hundred fifty raccoons and 1 striped skunk were hand vaccinated during this post-ORV sampling period.

Other Rabies Management Program Activities

Plum Brook Station Trapping.--From 23-25 July and 24-28 September 2007 WS conducted trapping on Plum Brook Station in Sandusky, Ohio (Erie County) (Figure 1) to monitor serology levels in an area that was experimentally baited in 2004. Blood and tooth samples were collected from 242 raccoons; 8 were euthanized and tested to enhance rabies surveillance. They all tested negative using the dRIT (Table 1).

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 122 opossums, 20 fox squirrels, 14 woodchucks, 9 Eastern cottontails (*Sylvilagus floridanus*), 7 domestic/feral cats, 3 mink (*Mustela vison*), 1 gray squirrel (*Sciurus carolinensis*), 1 red squirrel (*Tamiasciurus hudsonicus*), 1 American robin (*Turdus migratorius*), and 1 mallard (*Anas platyrhynchos*).

Non-target animals that were captured and euthanized by WS in 2007 included: 7 woodchucks, 2 opossums, and 2 domestic/feral cats. These animals were all euthanized at the request of property owners or to enhance rabies surveillance.

Rabies Laboratory Cooperation

As part of the ORV program in Ohio, WS cooperates with the Ohio Department of Health Laboratory (ODHL) and the CDC. There were 4,439 animals tested for rabies in Ohio in 2007 (Table 2), and 86 confirmed cases of rabies: 66 bats (*Chiroptera* spp.), 11 raccoons, and 9 skunks. All raccoons and skunks had raccoon rabies variant. Total samples tested by the ODHL, the CDC, and WS increased 5.4% in 2007, as compared to 2006 (n=4,210). Raccoons and skunks from northeast and eastern Ohio accounted for the largest testing increases, 17.5% and 53.3% respectively. The increase in sample submission was a result of increased sample collection by local health departments, and collection of odd behavior/sick/wounded animals during TVR activities within Cuyahoga, Geauga and Lake Counties. In 2008, cooperators anticipate an equal or greater number of animals will be tested for rabies given that raccoon rabies cases are still occurring within a 3 county area in northeastern Ohio.

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. These species accounted for 86.0% of enhanced surveillance

samples from within ORV counties in Ohio in 2007. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 89.8% of public health surveillance samples were from "other" animals (not raccoons, skunks, foxes, and coyotes).

Ohio Department of Health Laboratory.--The ODHL primarily tests animals for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure), although they have historically tested, and continue to test, hundreds of enhanced surveillance specimens annually (animals not involved in an exposure and usually submitted by WS). The Ohio Department of Health, Zoonotic Disease Program (ZDP) relies on local health departments to collect and submit animals for rabies testing. Historically, most jurisdictions have been unable to implement enhanced surveillance due to a lack of resources (staff and funding), thereby depending on public health surveillance to monitor rabies in Ohio. Over the last 3 years, WS has provided refrigerators to local health departments (to store animals prior to submission/testing), while ODH has provided reimbursement contracts with 14 northeast and eastern counties. These contracts provide local health departments with $70 per animal in compensation for collection, decapitation (usually by a veterinarian), shipment preparation, and staff costs related to animal submission. The ZDP also pays for shipping all animal heads to the ODHL for rabies testing ($35,000 per year) and provides the Laboratory $189,000 per year to support rabies testing. This assistance has led to an increase in rabies testing in Ohio since 2003 (when 3,223 samples were tested in the state). For more detailed information on rabies in Ohio over the last decade please visit: http://www.odh.ohio.gov/odhPrograms/idc/zoodis/rabies/rab1.aspx

Table 2. Animals tested for rabies via public health and enhanced surveillance systems from within ORV counties in Ohio and statewide, 2007 (rabies testing conducted by the Ohio Department of Health Laboratory, the Centers for Disease Control and Prevention, and Wildlife Services).

	Public health surveillance		Enhanced surveillance			
Species	**Statewide**	**Within ORV counties**	**Statewide**	**Within ORV counties**	**Unknown surveillance type**	**Statewide total**
Raccoons	255	116 (45.5%)	981	877 (89.4%)	14	1,250
Skunks	22	13 (59.1%)	69	55 (79.7%)	1	92
Foxes	6	3 (50.0%)	11	8 (72.7%)	0	17
Coyotes	4	2 (50.0%)	4	3 (75.0%)	0	8
Other[a]	2,527	637 (25.2%)	539	153 (28.4%)	6	3,072
Total	2,814	771 (27.4%)	1,604	1,096 (68.3%)	21	4,439

[a] Other animals included: bats, beaver, cats, chipmunks, cows, dogs, ferrets, goats, hamster, horses, llamas/alpacas, mink, mole, mice, muskrats, opossums, rabbits, rats, sheep, squirrels, voles, woodchucks (groundhogs), wolf, and wolf-dog hybrids.

Centers for Disease Control and Prevention.--The CDC tests animal brainstems for rabies as part of enhanced surveillance (specimens not involved in an exposure and usually collected by WS). As per protocol, WS sends all positives, indeterminates and 10% of the negatives found using the dRIT to the CDC for confirmation and variant typing. The CDC also analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA).

In 2007, the CDC tested and confirmed 20 wildlife brainstem samples as positive for raccoon variant rabies, found by Ohio WS using the dRIT. The CDC also tested and confirmed 10% of the dRIT negatives (n=92) tested and submitted by Ohio WS in 2007. In addition, Ohio WS submitted 1,768 blood serum samples for rabies VNA analysis to the CDC in 2007. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, WS live-trapped 1,981 unique raccoons; blood and tooth samples were collected from most of these animals. Serum samples from 1,768 animals (1,763 raccoons and 5 skunks) were sent to the CDC for rabies VNA analysis. At the time of this report, results were available on 740 raccoons captured during TVR efforts in April and May 2007 (Table 3). During April TVR, blood was drawn from raccoons to evaluate ORV efficacy from the previous fall baiting and then raccoons were hand vaccinated with 1 ml of Imrab3® rabies vaccine prior to release. This TVR effort was postponed due to inclement weather (snow and ice) and resumed in May. During May TVR, blood was drawn from raccoons to evaluate ORV efficacy from baiting on 24 April 2007 and raccoons were again hand vaccinated with 1 ml of Imrab3® prior to release. During the May efforts, there were 32 raccoons recaptured from the April efforts; blood was collected from 27 of them. Each of these 27 had been hand vaccinated in April. In May, 25 (92.6%) demonstrated a positive rabies antibody response (Table 3), (23 had no response in April and 2 showed a positive response in April and May). There were 2 raccoons that did not respond in April or May despite being hand vaccinated.

Raccoon tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA) and were pending at the time of this report.

Table 3. Serology results of raccoon biological samples collected by Wildlife Services during trap-vaccinate-release (TVR) activities in Ohio, April-May 2007.

	CA[a] TVR (April)[b]	CA TVR (May)[c]	CA TVR recaptures[d]
Sample collection timeframe	2-5 April	8-19 May	8-19 May
Weeks post-ORV	28	2-4	2-4
ORV bait type/distribution method	FMP/hand & helo	FMP/hand & helo	FMP/hand & helo
Unique raccoons	117	635	32
		Serology	
Testable blood samples	110	603	27
Positive rabies antibody response (≥0.05 IU)	13 (11.8%)	147 (24.4%)	25 (92.6%)

[a] CA=Contingency Action; ORV=oral rabies vaccination; FMP=fishmeal polymer.
[b] Conducted prior to annual ORV distribution in 2007; most recent baiting was September 2006.
[c] Conducted after ORV bait distribution on 24 April 2007; includes only unique raccoons not previously captured during April TVR.
[d] Raccoons recaptured in May from April TVR efforts; all 27 were given 1 ml of Imrab3® prior to release in April.

SUMMARY

In 2007, WS completed its eleventh year of cooperative participation in the Ohio ORV program. Over 1.1 million baits were distributed over the AR and CA ORV zones. The focus in 2007 was on a large-scale TVR effort that resulted in 1,285 animals being trapped, vaccinated, and released from the CA ORV zone. Enhancing rabies surveillance remained critical in 2007, with 921 animals being collected and tested by WS using the dRIT. In addition to continuing contingency actions in response to rabies outbreaks, WS conducted standard trapping activities 5-11 weeks post-ORV and collected blood serum samples from 303 raccoons and 2 skunks to monitor ORV efficacy. Wildlife Services continued to monitor long-term serology levels from experimental baitings that occurred in 2004 on Plum Brook Station by trapping 242 raccoons from that area.

In 2008, WS will continue to: enhance rabies surveillance in the AR and CA zones focusing on areas near major urban population centers (Cleveland and other Cuyahoga County cities); participate in ORV bait distribution; execute a more systematic and focused TVR program; and conduct post-ORV monitoring and evaluation in both zones. The Ohio ORV zones continue to be an integral part of a larger Appalachian effort that in 2007 included Maryland, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. Future ORV baiting strategies in Ohio will continue to be tied to national planning efforts to prevent the westward spread of raccoon rabies and explore strategies to eliminate this variant from the U.S.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
PENNSYLVANIA 2007

BACKGROUND

Raccoon (*Procyon lotor*) rabies was first reported in Pennsylvania in 1982. The first documented cases occurred in Bedford, Fulton, and Franklin Counties. Twelve years later raccoon rabies had become enzootic throughout the Commonwealth's 67 counties. Since 1995, >350 animals have been confirmed positive for rabies annually. The first oral rabies vaccine (ORV) baits were distributed in Pennsylvania during the fall of 2001; 138,602 baits were hand distributed across 1,875 km^2 (724 mi^2) within 2 counties in the northwest corner of the state. This baiting effort was tied to the Appalachian Ridge (AR) ORV zone, with the goal of strengthening the existing ORV zone in eastern Ohio and expanding it eastward to reduce the area where raccoon rabies occurs. In 2002 and 2003, the baiting program expanded to cover 25,189 km^2 (9,729 mi^2) in 18 western counties bordering Maryland, Ohio, and West Virginia. The program became an integral part of national efforts to create an ORV zone from Lake Erie to the Gulf of Mexico to prevent the westward spread of raccoon rabies. In 2004, Wildlife Services (WS) distributed baits across a similar (although slightly smaller) area of western Pennsylvania and also in previously ORV naïve areas of Cambria, Indiana, Somerset, and Westmoreland Counties (as a spring bait efficacy study coupled with a raccoon density study). The following year, the spring bait study (SBS) area was treated again, a live rabies challenge study was conducted (within the SBS area), and Pennsylvania's portion of the AR zone was baited. In 2007, ORV baiting occurred again in the western part of state (Figure 1), density studies were conducted in Allegheny County, and more emphasis was placed on enhanced rabies surveillance. The Pennsylvania Department of Agriculture (PDA) provided the state leadership for the baiting effort, while WS provided wildlife management leadership and contributed significant funding. This cooperative initiative should create a vaccinated area of sufficient scope and allow for the exploration of methods to eliminate raccoon rabies from Pennsylvania.

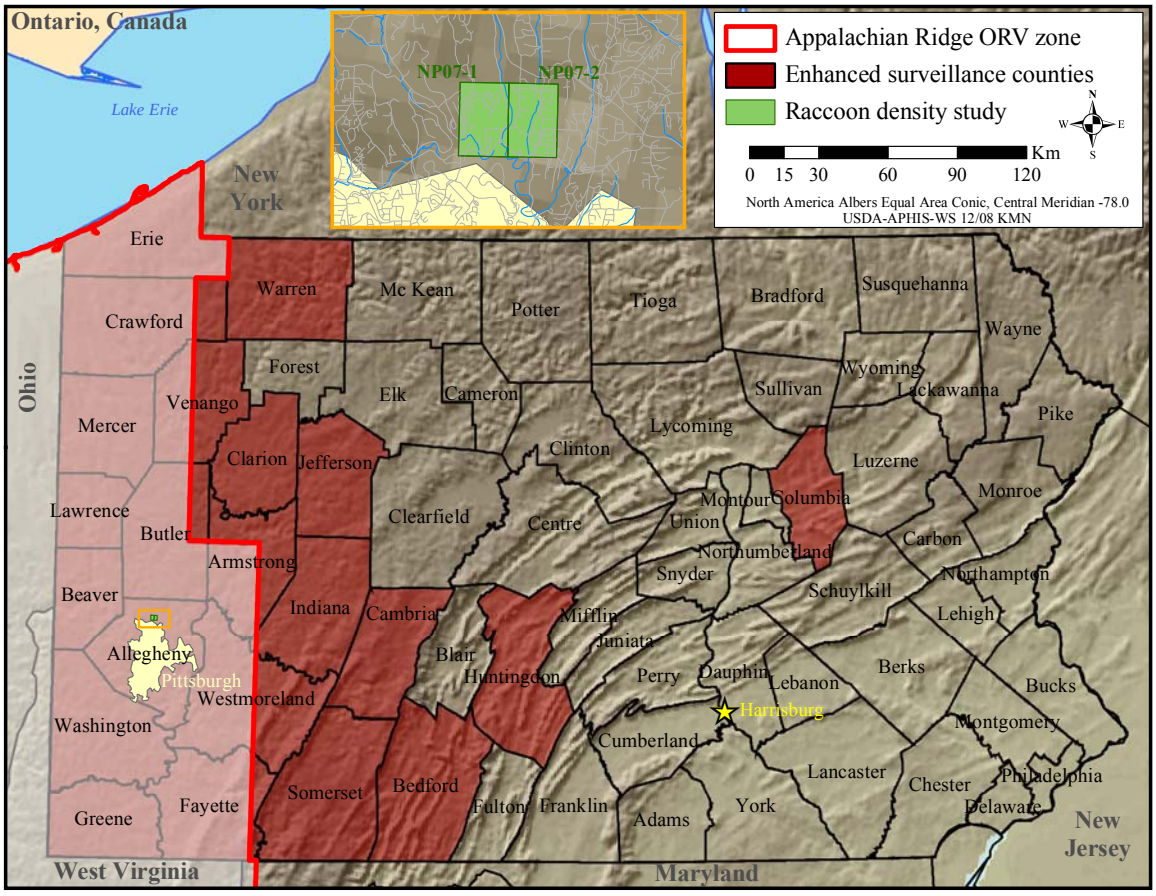

Figure 1. Cooperative rabies management program activities in Pennsylvania, 2007.

ORV PROGRAM 2007

Bait Distribution

For the seventh consecutive year in 2007, WS participated in bait distribution efforts throughout western Pennsylvania; 1,220,340 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 14 counties in the western part of the state (Figure 1). The Pennsylvania portion of the AR ORV zone encompassed 16,613 km^2 (6,414 mi^2) and was aerial baited during two separate bait campaigns. From 12-14 August, during aerial baiting out of Port Meadville, Pennsylvania, 520,105 fishmeal-coated sachets (CS) baits were distributed via fixed-wing aircraft provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA) in portions of Armstrong, Beaver, Butler, Crawford, Erie, Lawrence, Mercer, Venango, and Westmoreland. From 23-28 August, during aerial baiting out of Buckhannon, West Virginia, 313,093 CS baits were distributed via fixed-wing aircraft provided by the Ontario Ministry of Natural Resources in portions of Allegheny, Beaver, Fayette, Greene, Washington, and Westmoreland. During both baiting events, WS personnel from Pennsylvania, Maryland, Ohio, and West Virginia served as navigators and flight crew in the planes. Ground support for the flights was offered by: the Ohio Department of Health, the Ohio National Guard, the Pennsylvania Game Commission, the PDA, the PDH, and WS employees.

From 17 July to 4 August, 387,142 fishmeal polymer (FMP) baits were distributed via ground operations (hand baiting) in areas too populated to bait by air. During ground bait operations, assistance was provided to WS by: the PDA, the Pennsylvania Department of Health (PDH), the Erie County Department of Health, and the Allegheny County Health Department (ACHD). Since its program inception in 2001, WS has distributed 9,157,640 ORV baits in Pennsylvania.

Enhanced Surveillance

In 2007, WS conducted enhanced surveillance of raccoon rabies by collecting, submitting, and testing suspect rabid animals from counties in or near the Pennsylvania ORV zone. Wildlife Services collected animals by the following methods: 1) humanely euthanizing (according to the American Veterinary Medical Association's Panel on Euthanasia recommendations) raccoons that had puncture wounds/bite marks, exhibited disorientation, or showed signs of illness during trapping activities; 2) conducting road kill surveys and collecting mammals in suitable testing condition; 3) obtaining wildlife reported by Pennsylvania residents as displaying rabies-like symptoms; and 4) obtaining wildlife from nuisance wildlife control officers. Wildlife Services also continued to work with state and local health departments to increase the number of enhanced surveillance samples for rabies testing. As a result of enhanced surveillance efforts in western and central Pennsylvania, WS cooperated to collect and submit 3,269 animals for rabies testing (Table 1). Of those samples, 85 animals (2.6%) tested positive for rabies; all terrestrial (non-bat) animals had the raccoon variant.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Since 2005, Pennsylvania WS personnel have been conducting dRIT for all non-human and non-domestic exposure animals they collected. In 2007, WS tested 3,135 enhanced surveillance samples (95.6%) using the dRIT, with 61 positives. All positives and 10% of all negatives were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples and typed all non-bat positives as raccoon rabies variant and all bat positives as bat variant. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Pennsylvania.

Table 1. Animals submitted for rabies testing by Wildlife Services in or adjacent to ORV counties in Pennsylvania, 2007 (rabies positives in parentheses; bats were bat variant, non-bats were raccoon variant).

County	Raccoon	Skunk	Red Fox	Gray Fox	Coyote	Other[a]	Total
Allegheny	991 (13)	87 (1)		1		12	1,091 (14)
Armstrong	19 (1)	4				6	29 (1)
Beaver	106 (1)	2	2	2		2	114 (1)
Bedford[b]	3						3
Butler	79 (3)	2	1		1	5	88 (3)
Cambria[b]	20 (9)	7	1			8	36 (9)
Clarion[b]	1						1
Columbia[b]	1						1
Crawford	63	4		1		1	69
Erie	549 (1)	344	2			71 (1[c])	966 (2)
Fayette	35	7	1	2		8	53
Greene	10					3	13
Huntingdon[b]	2	3					5
Indiana	46 (2)	28	2			39	115 (2)
Jefferson	1						1
Lawrence	99 (1)	3			1	13	116 (1)
Mercer	78	5				3	86
Somerset[b]	31 (6)	4 (3)	1	1 (1)		5	42 (10)
Venango	7	1				1	9
Warren						3	3
Washington	85 (4)	4		1	2	5	97 (4)
Westmoreland	272 (37)	16	7	6		30 (1[c])	331 (38)
Total	2,498 (78)	521 (4)	17	14 (1)	4	215 (2)	3,269 (85)

[a] Other animals included: bat, black bear, cat, dog, fisher, mink, muskrat, opossum, weasel, and woodchuck.
[b] ORV not applied in this county.
[c] Rabid bat with bat variant.

Population Monitoring

In 2007, Pennsylvania was selected (alongside Alabama and Vermont) to perform paired 15-day density studies, replicated 30 days apart, to continue to test the National Rabies Management Program's (NRMP's) "high density protocol" for indexing raccoons (50 cage traps set on a target study area of 3 km² [1.2 mi^2] for 15 consecutive nights). Two studies were conducted prior to annual ORV (NP07-1A and NP07-2A) and the studies were replicated 30 days later (post-ORV distribution); 1B was on the same site as 1A, and 2B on the same site as 2A. The studies were conducted within low intensity developed (urban/suburban) areas on the northern periphery of Pittsburgh (Figure 1 and inset). All 4 study areas had been treated with ORV (hand baited area) since 2002.

During the first pair of studies in July, 245 unique raccoons were captured (Table 2). During the second pair of studies in Aug.-Sept., 131 raccoons were captured that were unique to that sampling period. Fifty-seven of the 131 raccoons had been previously captured during the first pair of studies. Most of the raccoons in both sampling periods were administered 1 ml of rabies vaccine prior to release to bolster the immunity of the populations. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

During the first pair of studies in July, blood and tooth samples were collected from most of the unique raccoons. Samples were collected from most raccoons captured in the second sampling period (Aug./Sept. studies) that had not been previously captured in July. However, there were 57 raccoons captured in the second sampling period (post-ORV) that had been previously captured in July (prior to annual ORV), but blood was only collected from 3 individuals. If similar studies are conducted in the future, efforts will be made to collect blood from raccoons captured post-ORV to determine if changes in serologic titers occur after ORV distribution.

Table 2. Index to raccoon densities in Allegheny County, Pennsylvania, 2007.

	NP07-1A	NP07-2A	NP07-1B	NP07-2B
Time of study	16-31 July		26 Aug.-10 Sep.	
Weeks post-ORV	43-45		3-5	
Macrohabitat	Urban/suburban		Urban/suburban	
Target trap nights	750	750	750	750
Unique raccoons	121	124	67[a]	64[b]
Recaptured raccoons	14	29	16	15
Non-target captures[c]	104	62	85	30
Area (km^2)	3.00	3.00	3.00	3.00
Raccoon density index[d]	40.3	41.0	22.3	21.3

[a] Thirty raccoons were captured in the first pair of studies, but were unique to the second pair of studies.
[b] Twenty-seven raccoons were captured in the first pair of studies, but were unique to the second pair of studies.
[c] May include non-target captures and traps that were otherwise unavailable to capture a raccoon (sprung, stolen, etc.).
[d] Unique raccoons/km^2.

Post-ORV Monitoring

Sampling for post-2007 ORV evaluation was initiated on 26 August with the second pair of density studies in Allegheny County (see above). Non-density study trapping was conducted 15 October to 9 November, 7-13 weeks post-ORV. Cage traps and various types of lures were used during non-density trapping to capture 233 unique raccoons from Allegheny, Armstrong, Beaver, Butler, Crawford, Erie, Fayette, Greene, Lawrence, Mercer, Washington and Westmoreland Counties. Most raccoons (226) were immobilized, processed and released. The remaining 7 animals were either euthanized to enhance rabies surveillance or found dead in a trap. Two of them (1 each from Allegheny and Butler Counties) tested positive for rabies using the dRIT (Table 1). In total (density and non-density trapping), 364 raccoons were captured that were unique to the post-2007 ORV evaluation period. Blood samples were collected from 266 of them.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 116 opossums (*Didelphis virginiana*), 25 woodchucks (*Marmota monax*), 16 domestic/feral cats (*Felis catus*), 7 striped skunks (*Mephitis mephitis*), 5 Eastern cottontails (*Sylvilagus floridanus*), 2 Norway rats (*Rattus norvegicus*), 1 chipmunk (*Tamias striatus*), 1 fox squirrel (*Sciurus niger*), 1 gray squirrel (*Sciurus carolinensis*), 1 red squirrel (*Tamiasciurus hudsonicus*), 1 muskrat (*Ondatra zibethicus*), 1 American robin (*Turdus migratorius*), and 1 English house sparrow (*Passer domesticus*).

Non-target animals captured and euthanized by WS in 2007 included 6 domestic/feral cats and 3 striped skunks. The cats were euthanized due to human exposures or abnormal behavior and the skunks were euthanized for nuisance reasons at the request of landowners. All 9 animals tested negative using the dRIT (Table 1). In addition, 1 red squirrel was found dead in a cage trap.

Rabies Laboratory Cooperation

Wildlife Services' ORV program in Pennsylvania cooperates with the PDH Bureau of Laboratories (PDHBL), the PDA Veterinary Laboratory (PDAVL), the ACHD, and the CDC. Wildlife Services has had an efficient and cooperative relationship with all 4 laboratories since 2001, and they remain critical to the surveillance and monitoring phases of the ORV program in Pennsylvania.

Pennsylvania Department of Health Bureau of Laboratories.--The PDHBL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed human exposure, usually submitted by Wildlife Conservation Officers and the public). The PDHBL tested 3,351 animals for the rabies virus in 2007, representing a 10.3% decrease from 2006. Animals were submitted from all 67 counties throughout the state, including 520 animals (15.5%) from the 13 ORV counties. For more general information on rabies from the PDH please visit: http://www.dsf.health.state.pa.us/health/cwp/view.asp?A=171&Q=230513

Pennsylvania Department of Agriculture Veterinary Laboratory.--The PDAVL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed domestic animal exposure, usually submitted by wildlife conservation officers, veterinarians, and the public). The PDAVL tested 1,697 animals for the rabies virus in 2007, representing a 16.1% increase from 2006. Animals were submitted from all 67 counties throughout the state, including 249 animals (14.7%) from the 13 ORV counties. For more general information on rabies from the PDA please visit:
http://www.agriculture.state.pa.us/agriculture/cwp/view.asp?q=127956

Allegheny County Health Department.--The ACHD tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed human or domestic animal exposure) within Allegheny County (and sometimes nearby counties). The ACHD tested 453 animals for the rabies virus in 2007, representing a 0.4% increase from 2006. Animals were submitted to the ACHD from 8 counties in western Pennsylvania: Allegheny, Beaver, Butler, Carbon, Fayette, Mercer, Washington, and Westmoreland. All but 1 sample (99.8%) were submitted from a county treated with ORV. For more general information on raccoon rabies from the ACHD please visit: http://www.achd.net/raccoon/raccoonsrabies.htm

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). Pennsylvania WS collected 512 blood serum samples in 2007 for rabies VNA analysis and will ship them to the CDC in 2008. This is approximately the same number of samples collected in 2006 that will also be submitted to the CDC in 2008. The Pennsylvania ORV program anticipates similar numbers of serum sample submissions to the CDC from 2008 collected samples. For more information about the rabies virus (its natural history, diagnosis, epidemiology, and prevention and control) on a national level please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2006 and 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, 2006 and 2007 evaluation data were not available. Serum samples from 2006 and 2007 will be submitted to the CDC in 2008. Tooth samples from 2006 and 2007 will be sent to Matson's Laboratory LLC (Milltown, Montana, USA) in 2008.

SUMMARY

During 2007, WS completed its seventh year of cooperative participation in the Pennsylvania rabies management program. Activities included distributing 1,220,340 ORV baits by boat, hand, and from aircraft, across 14 counties encompassing 16,613 km^2. Four raccoon density studies were conducted in low intensity developed areas on the edge of Pittsburgh (Allegheny County) with densities ranging from 21-41 raccoons/km^2. Efforts in 2007 also focused on enhanced rabies surveillance, with 3,269 samples collected from 22 counties (up from 2,712 animals in 2006). Over 9 million baits have been distributed in Pennsylvania since the ORV program began in 2001. Pennsylvania's baiting effort is part of a larger AR ORV zone, which in 2007 included Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

In 2008, WS will continue to work cooperatively to distribute ORV baits in the western part of the state. Even greater emphasis will be placed on enhanced rabies surveillance. The Pennsylvania ORV program is integral to national planning efforts to contain raccoon rabies and explore strategies to eliminate this unique variant of the virus.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
TENNESSEE 2007

BACKGROUND

In 2002, an oral rabies vaccination (ORV) program was initiated in Tennessee as part of Wildlife Services (WS) National Rabies Management Program (NRMP) to stop the westward spread of the raccoon (*Procyon lotor*) variant of rabies. Raccoon rabies had not been found in Tennessee at that point, but was reported across the border in nearby North Carolina. In an effort to stay ahead of the disease front, WS extended the Appalachian Ridge (AR) ORV zone (which began at Lake Erie) into northeastern Tennessee. In June 2003, the rabies front, which had stalled in North Carolina, crossed into Tennessee and 4 cases of raccoon rabies were confirmed in Carter County, while 1 case was confirmed in Johnson County. There were no cases found in this area during 2004 despite increased surveillance. In 2005, 6 cases were confirmed in wildlife in the area, including positives in Washington and Unicoi Counties, where raccoon rabies had not been previously documented. Four cases were confirmed in northeastern Tennessee in 2006; 1 case in Johnson county and 3 cases in Unicoi County. In 2007, 25 cases were confirmed in northeastern Tennessee, including 3 positives in Sullivan County and 1 positive in Greene County, where raccoon rabies had not been previously documented. A majority of cases in 2007 occurred in Washington County (n=17).

In November 2003, WS established the Georgia-Alabama-Tennessee (GAT) ORV zone where the Georgia and Alabama borders meet southern Tennessee. At the time, raccoon rabies was in northwestern Georgia and moving westward. The Alabama-Coosa River system to the south and the Appalachian Mountains to the north were serving as potential natural barriers to the westward spread of raccoon rabies. The GAT zone was established to help fill a gap between these potential barriers and to prevent the spread of raccoon rabies into the Tennessee Valley and subsequently the interior of the United States. In January 2004, raccoon rabies entered southeastern Tennessee from Georgia and reached the GAT ORV zone. In response to the first positive case of raccoon rabies inside the GAT zone, WS began baiting the city of Chattanooga and surrounding areas of Hamilton County in the spring, while baiting these areas again in the fall as part of the larger GAT ORV effort. During 2004, 14 cases of raccoon rabies were documented in wildlife in Hamilton County. During 2005, only 1 animal (a raccoon) was confirmed with raccoon rabies in Hamilton County and the virus was not detected in any surrounding counties. Although no cases of raccoon rabies were documented in Hamilton County in 2006, 1 case was confirmed in adjacent Bradley County in a gray fox (*Urocyon cineroargenteus*). In 2007, 1 raccoon case was confirmed in Hamilton County, but no additional cases were detected in Bradley or other surrounding counties.

Despite the first positive case of raccoon variant rabies emerging in a red fox in Knox County in 2005 (ORV naïve area), there were no additional cases in the area in 2006 or 2007. However, in response to the 2005 case, the enhanced surveillance area was expanded to include Cumberland, Roane, Morgan, Anderson, Campbell, Union, and Claiborne counties in 2006, and enhanced surveillance efforts were greatly increased in Knox County and surrounding ORV naïve counties.

In Tennessee, the AR and GAT ORV programs are being conducted by WS, in cooperation with the Tennessee Department of Health (TDH), Tennessee Department of Agriculture, Tennessee Wildlife Resources Agency (TWRA), Chattanooga/Hamilton County Department of Health, and the Centers for Disease Control and Prevention (CDC). Numerous individual landowners and many federal, state, and local agencies provide WS access to private and government owned properties for ORV program trapping and monitoring. Many other agencies and numerous animal control departments, nuisance wildlife control operators, and wildlife rehabilitators assist WS by collecting suspicious acting and road killed animals for rabies testing in the enhanced surveillance zone.

ORV PROGRAM 2007

Bait Distribution

For the sixth consecutive year, WS participated in bait distribution efforts in northeastern Tennessee (AR ORV zone) and for the fifth year in southeastern Tennessee (GAT ORV zone); 840,222 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 11,570 km^2 (4,467 mi^2) (Figure 1). Since its program inception in 2002, WS has distributed 3,089,598 ORV baits in Tennessee. Aircraft and pilots for both Tennessee ORV programs in 2007 were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS provided ground support and served as navigators and flight crew in the planes.

Georgia-Alabama-Tennessee.--In 2007, the Tennessee portion of the GAT ORV zone was the same as in 2006 with 340,330 baits being distributed over 4,497 km^2 (1,736 mi^2) in 10 counties (Figure 1). Aerial baiting was based out of Albertville, Alabama from 3-6 October, with 203,185 CS baits distributed via fixed-wing aircraft. From 28 September-2 October, 137,145 FMP baits were distributed by hand including double density hand baiting in Chattanooga.

Appalachian Ridge.--In 2007, the Tennessee portion of the AR ORV zone was the same as in 2006 with 499,892 baits being distributed over 7,073 km^2 (2,731 mi^2) in 12 counties (Figure 1). Aerial baiting was based out of Greenville, Tennessee from 8-10 October, with 440,492 fishmeal-coated sachet (CS) baits distributed via fixed-wing aircraft. From 5-11 October, 59,400 fishmeal polymer (FMP) baits were distributed by hand in areas too populated to bait by air. Several areas in Sullivan and Washington counties were baited by hand at double density and one region in Washington County was baited at double density by fixed-wing aircraft in response to a large number of positives occurring in the area in 2007.

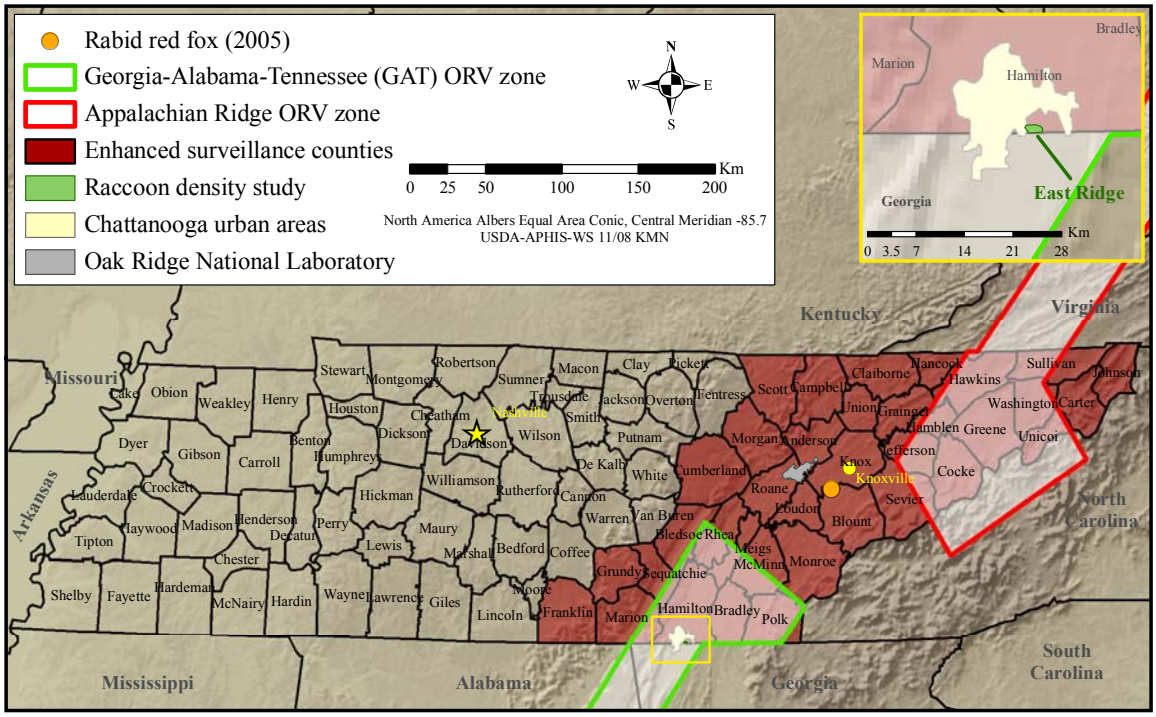

Figure 1. Wildlife Services cooperative rabies management program activities in Tennessee, 2007.

Enhanced Surveillance

In 2007, WS continued to enhance surveillance for the raccoon variant of the rabies virus in Tennessee. Wildlife Services personnel continued to recruit state and local agencies to collect suspect animals for testing. An emphasis was placed on raccoons, striped skunks (*Mephitis mephitis*), gray foxes, red foxes (*Vulpes vulpes*), and coyotes (*Canis latrans*) that exhibited strange behavior, were found dead in unusual places, or were fresh road killed animals. The enhanced surveillance area included 36 counties in eastern Tennessee, creating a surveillance corridor along the borders with Virginia, North Carolina, Georgia and Alabama (Figure 1). During these efforts WS cooperated to collect and submit 1,509 animals for rabies testing: 1,230 raccoons, 209 striped skunks, 35 coyotes, 25 gray foxes, 9 red foxes, and 1 woodchuck (*Marmota monax*). Twenty of these animals tested positive for rabies including 10 raccoons (all with raccoon variant) and 10 skunks (7 with north central skunk variant and 3 with raccoon variant). In response to the 2005 confirmed positive red fox in Knox County, an emphasis was placed on collecting animals for rabies testing from this county. Working cooperatively with local nuisance control operators and other entities, WS submitted 682 animals from Knox County in 2007.

Tennessee WS personnel attended Direct Rapid Immunohistochemistry Testing (dRIT) training in May 2005 and February 2006 at the CDC in Atlanta, Georgia. A Biosafety Level 2 (BSL-2) laboratory at the College of Veterinary Medicine at the University of Tennessee was secured and fitted to conduct this test through part of 2006.

During 2006, WS converted a travel trailer to a BSL-2 laboratory, and all dRIT-testing by Tennessee WS has occurred at this site since its completion. During 2007, WS tested 1,499 animals (99.3%) using the dRIT (Table 1); the remaining 10 enhanced surveillance samples were tested by TDH Laboratories. Ten percent of the dRIT tested negatives were sent to the CDC for confirmation. Using the dFA test, the CDC had 99.3% agreement with the WS dRIT results. Wildlife Services detected a false positive via dRIT that was confirmed negative by dFA at the CDC. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Tennessee.

Table 1. Animals tested for rabies by Wildlife Services using the Direct Rapid Immunohistochemistry Test (dRIT) in or adjacent to ORV counties in Tennessee, 2007 (rabies positives in parentheses).

County	Raccoon	Skunk	Coyote	Gray Fox	Red Fox	Total
Anderson[a]	73	28				101
Bledsoe	3					3
Blount[a]	100	14	10	3		127
Bradley	9	6		4	1	20
Campbell[a]		1				1
Carter	1		1			2
Cocke	4	3	2	2		11
Cumberland[a]	13		2	1		16
Franklin[a]	15	1				16
Grainger	5					5
Greene	31	13 (7)[b]		1	2	47 (7)
Grundy[a]	5		3	1		9
Hamblen	20	1		1	1	23
Hamilton	83 (1)[c]					83 (1)
Hancock	1					1
Hawkins	2	1				3
Jefferson	38	5 (1)[d]	4	2		49 (1)
Johnson[a]	4 (1)[c]	2				6 (1)
Knox[a]	567	94	10	4	4	679
Loudon[a]	58	7			1	66
Marion	19					19
McMinn	15	5	2	3		25
Meigs	5					5
Monroe	16	3				19
Morgan[a]		1				1
Rhea	1	2		1		4
Roane[a]	63	2	1	1		67
Sequatchie	4					4
Sevier	16	10				26
Sullivan	4 (1)[c]	3				7 (1)
Unicoi	4	1				5
Washington	44 (6)[c]	4 (2)[c]		1		49 (8)
Total	1,223 (9)	207 (10)	35	25	9	1,499 (19)

[a] ORV not applied in this county.
[b] Six skunks with north central skunk variant; 1 skunk with raccoon variant.
[c] Raccoon variant.
[d] North central skunk variant.

Population Monitoring

In August 2007, WS conducted a raccoon density study using the NRMP standard protocol of 50 cage traps set on a target study area of 3 km^2 (1.2 mi^2) for 10 consecutive nights. The study was a mixture of suburban, commercial, and wooded recreational areas in East Ridge, Tennessee (GAT ORV zone) at an elevation of 210 meters (Figure 1 inset). The study was a replicate of a study conducted in 2005 on the same site. The 2007 study was conducted prior to annual ORV for the year and 59 unique raccoons were captured, yielding an index to raccoon density of 25.2 raccoons/km^2; this was very similar to the index in 2005 (Table 2). In 2007, one raccoon was found dead in a trap and tested negative for rabies using the dRIT. The remaining raccoons were immobilized, processed, and released; blood and teeth were collected from most of them. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 2. Index to raccoon densities in East Ridge, Tennessee, 2005 and 2007.

	East Ridge 2005	East Ridge 2007
Time of study	5-15 December	6-16 August
Weeks post-ORV	7-8	42-43
Macrohabitat	Urban/suburban	Urban/suburban
Target trap nights	500	500
Unique raccoons	62	59
Recaptured raccoons	13	37
Non-target captures[a]	68	44
Area (km^2)	2.34	2.34
Raccoon density index[b]	26.5	25.2

[a] Includes traps that were sprung but with no animal captured.
[b] Unique raccoons/km^2.

Post-ORV Monitoring

Georgia-Alabama-Tennessee.--Post-ORV sampling for Tennessee's 2007 GAT ORV zone was initiated on 5 November. Cage traps were used to capture 151 unique raccoons from Hamilton County; they were all immobilized, processed and released.

Appalachian Ridge.--Post-ORV sampling for Tennessee's 2007 AR ORV zone was initiated on 26 November. Cage traps were used to capture 149 unique raccoons from Greene, Hamblen, Hawkins, Sullivan and Washington Counties; all unique raccoons were immobilized, processed and released. In addition, 6 unique striped skunks were captured, 3 of which were immobilized, processed, and released.

Other Rabies Management Program Activities

In May 2007, WS trapped raccoons as part of a nuisance control effort at Oak Ridge National Laboratory (ORNL), a U.S. Department of Energy facility in Anderson and Roane Counties. The study site was ORV naïve and consisted primarily of highly developed commercial areas, with some deciduous forest interspersed. Over 250 trap nights, 49 unique raccoons were trapped and euthanized; they all tested negative for rabies using the dRIT (Table 1).

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 179 opossums (*Didelphis virginiana*), 41 domestic/feral cats (*Felis catus*), 3 eastern cottontails (*Sylvilagus floridanus*), 2 groundhogs (*Marmota monax*), and 2 box turtles (*Terrapene carolina*).

Rabies Laboratory Cooperation

The ORV program in Tennessee cooperates with the TDH laboratories in Jackson, Nashville, and Knoxville and the CDC, as well as with representatives from the College of Veterinary Medicine at the University of Tennessee, Knoxville.

Tennessee Department of Health Laboratories.--Each of the TDH labs is responsible for testing animal brainstems for rabies within their designated region. Positive samples are sent to the Nashville Branch Laboratory for rabies variant typing. The Knoxville Branch Regional Laboratory (KBL) is responsible for the East Tennessee region which includes 26 of the 36 designated enhanced surveillance counties.

The KBL tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure) and enhanced surveillance (specimens not involved in an exposure) at the request of WS. The KBL tested 1,074 brainstem samples for the rabies virus in 2007 (Table 3). This represents a 9.9% increase from the number of samples tested in 2006. The 2007 samples were submitted from 37 counties in the East Tennessee region and from 35 counties within the designated enhanced rabies surveillance zone. Thirteen of these samples tested positive for raccoon variant rabies (12 raccoons and 1 skunk). The KBL also handles the disposal of medical waste created during WS ORV surveillance, monitoring and evaluation projects.

Raccoons, skunks, foxes, and coyotes are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 77.0% of the animals tested for rabies in the East Tennessee region in 2007 are reported by WS as "other." For general information on rabies in Tennessee please visit: http://www.state.tn.us/health/.

Table 3. Animal tested for rabies by the Tennessee Department of Health, Knoxville Branch Laboratory in the East Tennessee Region, 2007 (percent of animals tested from enhanced surveillance zone in parentheses).

	East Tennessee region	Within Wildlife Services' enhanced rabies surveillance zone
Raccoons	172	172 (100%)
Skunks	56	56 (100%)
Foxes	16	16 (100%)
Coyotes	3	3 (100%)
Other[a]	827	820 (99.2%)
Total	1,074	1,067

[a] Other animals included: bats, cats, cattle, chipmunks, deer, dog, ferret, gerbils, goats, guinea pigs, hamsters, horses, mice, moles, opossums, rabbits, and rats.

As part of the ongoing cooperative relationship between TDH and WS, Tennessee WS participated in several collaborative studies with TDH during 2007. Wildlife Services began collecting ticks from all raccoons, skunks, foxes, and coyotes processed during enhanced surveillance and post-ORV trapping activities, beginning in the spring of 2007. Ticks are in the process of being analyzed by TDH for detection of various tick-borne diseases, including Rocky Mountain Spotted Fever (RMSF; caused by *Rickettsia rickettsii*) and other related diseases belonging to genus *Rickettsia*. To date, more than 431 ticks have been collected by Tennessee WS, and will continue to be collected during all enhanced surveillance and trapping activities in 2008.

Preliminary results from analysis of ticks collected late in 2007 indicated that 24.8% were positive for the presence of *Rickettsia* tick-borne diseases. Species identified as part of the analysis were: the American dog tick (*Dermacentor variabilis*), the lone star tick (*Amblyomma americanum*), and 3 species from the genus *Ixodes*. Although RMSF is an important disease in the southeastern U.S., no ticks were identified as positive for *R. rickettsii*. In contrast, ticks were positive for *R. Montana*, *R. amblyomii*, and *R. parkeri*, 3 other strains of spotted fever group tick-borne diseases.

For a second study being conducted by TDH, WS began submitting wildlife serum samples (primarily raccoons) for detection of Chagas disease neutralizing antibodies during the fall of 2007. Chagas disease, caused by *Trypanosoma cruzi*, affects almost 20 million people in Latin America, and is transmitted by blood-feeding reduviid insects (i.e., kissing bugs). Tennessee is one of 4 states from which a human case of Chagas disease has been reported since 1955, but the *T. cruzi* parasite has been detected in domestic and wild mammals in many areas of the southeastern U.S. Approximately 713 serum samples to date have been sent to TDH, including 184 samples in 2005, 240 in 2006, and 289 in 2007. The TDH completed a preliminary analysis of a portion of the raccoon sera

submitted by WS. Of 128 samples tested to date (representing 6 eastern Tennessee counties), 22.6% were seropositive for *T. cruzi*. Animals collected from 5 of the 6 counties had positive antibodies for *T. cruzi*, with seroprevalence ranging from 15.2 – 38.5% per county.

The TDH is also working to create a real-time online disease tracking system for the entire state. This system would allow laboratory personnel to input test results immediately for a variety of diseases. It would allow health professionals to quickly identify disease trends and help in identifying possible breaches in the ORV zones should they occur. The online disease tracking system is tentatively slated to become functional in late 2008 or early 2009. In addition, the KBL began rabies variant typing in 2006, further increasing the abilities of the TDH and WS to respond quickly to potential breaches in the ORV zones.

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). Tennessee WS submitted 404 blood serum samples for rabies VNA analysis to the CDC in 2007. This represents a 31.7% increase from the 276 samples submitted by WS in 2006. The increase in sample numbers is attributed to conducting a 10-day density study and an additional 5-day trapping event in 2007, whereas there were no density studies conducted in 2006. The Tennessee ORV program anticipates an increase in number of serum sample submissions to the CDC in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

University of Tennessee.--The College of Veterinary Medicine at the University of Tennessee (UT) has been a longstanding cooperator of Tennessee WS since the rabies management program began in 2002. To further enhance the cooperative relationship with UT, WS submitted raccoon carcasses processed during enhanced surveillance to a veterinarian at UT for analysis of the occurrence of raccoon roundworm (*Baylisascaris procyonis*) in eastern Tennessee animals. One hundred eighteen carcasses from 16 counties were submitted for analysis, and 14.4% demonstrated presence of *B. procyonis*.

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, WS live-trapped 408 unique raccoons: 49 in an ORV naïve area; 59 were 42-43 weeks post-2006 GAT ORV (during a density study); 151 were 4-8 weeks post-2007 GAT ORV; and 149 were 7-9 weeks post-2007 AR ORV bait distribution (Table 4). Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Biomarker results were available, but age results were pending from Matson's at the time of this report.

In addition to raccoons, blood samples were collected from 3 skunks and 1 opossum (all during post-2007 AR ORV). Detectable rabies antibodies were present in 1 skunk sample (at 0.1 IU).

Table 4. Results of raccoon samples collected by Wildlife Services during the cooperative rabies management program in Tennessee, 2007.

	ORNL[a] evaluation	Density Study evaluation	GAT evaluation	AR evaluation
Sample collection timeframe	14-18 May	6-16 Aug.	5-30 Nov.	26 Nov.-14 Dec.
Weeks post-ORV	n/a[b]	42-43	4-8	7-9
Unique Raccoons	49	59	151	149
	Serology			
Testable blood samples	49	55	151	149
Positive rabies antibody response (≥0.05 IU)	5 (10.2%)	13 (23.6%)	72 (47.7%)	40 (26.9%)
	Tetracycline biomarker			
Testable tooth samples	0[c]	40	119	108
Presence of tetracycline biomarker	n/a	14 (35.0%)	54 (45.4%)	30 (27.8%)

[a] ORNL=Oak Ridge National Laboratory; GAT=Georgia-Alabama-Tennessee; AR=Appalachian Ridge.
[b] Samples were collected in an ORV naïve area (never before treated with ORV).
[c] Teeth were not collected during ORNL trapping; jawbones were collected to extract canine teeth for later analysis.

SUMMARY

In 2007, Tennessee WS conducted its sixth year of rabies control activities in the AR ORV zone and its fifth year in the GAT ORV zone. During bait distribution activities, 643,677 baits were distributed by air and 196,545 baits by hand and in portions of 22 eastern Tennessee counties. Trapping resulted in the capture of 408 unique raccoons with 404 serum samples being collected for rabies VNA testing. Enhanced surveillance efforts resulted in the collection and testing of 1,505 animals, including 680 animals from Knox County.

During 2008, WS will continue to conduct intensive enhanced surveillance in Knox and surrounding counties to determine the prevalence of raccoon rabies. Particular emphasis will be placed on enhanced surveillance in Washington County and the Tri-Cities area (Kingsport, Johnson City, and Bristol), in light of the high number of positive cases in Washington County in 2007 (n=17). Wildlife Services will continue to conduct and coordinate enhanced surveillance for raccoon rabies throughout eastern Tennessee. Efforts will be made to recruit additional local law enforcement agencies, TWRA personnel, and the general public to report and/or collect suspect rabid animals in 36 counties. Additional density study areas and monitoring sites will be secured to look at potential differences in raccoon population trends among different habitats, elevations, and ORV versus naïve zones.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
TEXAS 2007

BACKGROUND

Two canine rabies epizootics emerged in Texas in 1988: 1 involving coyotes (*Canis latrans*) and dogs (*C. familiaris*) in south Texas and the other involving gray foxes (*Urocyon cinereoargenteus*) in west-central Texas. The south Texas epizootic has resulted in 2 human deaths and required over 3,000 people to receive post exposure rabies treatment. In 1994, the public health threat created by these 2 expanding epizootics prompted the Governor of Texas to declare rabies a state health emergency. By 1996, the 2 epizootics expanded to involve 69 Texas counties. In February 1995, an oral rabies vaccination program (ORVP) was initiated as a multiyear effort with a goal of creating zones of vaccinated coyotes and gray foxes (January 1996) along the leading edges of the epizootics, thereby halting the spread of the virus. The ORVP is a cooperative program involving: Wildlife Services (WS); the Texas Department of State Health Services (TDSHS); the Texas AgriLife Extension Service -Wildlife Services Unit; the Texas National Guard; the Centers for Disease Control and Prevention (CDC); the Department of Defense Veterinary Food Analysis and Diagnostic Laboratory (DOD-VFADL) at Sam Houston; and other local, state, and federal agencies.

Early in February 2007, two cases of rabies involving the Texas Fox variant were confirmed by the TDSHS west of the recently completed west-central Texas ORV zone. One case occurred at Rankin, 1.6 km (0.9 mi) outside the vaccination zone and the other near Grand Falls, 42.0 km (26.0 mi) outside the vaccination zone (Figure 1). The TDSHS and WS responded to these rabies cases by establishing an enhanced rabies surveillance area. Within this area, both agencies increased public awareness of the rabies outbreak and the need for the testing of unusual or sick acting animals by utilizing the TDSHS Health Alert Network, the outreach capabilities of Texas AgriLife Extension Service and local media releases. Two contingency actions were initiated (February and March) not only to contain an outbreak of the Texas Fox variant in far west-central Texas but also to contend with a high number of coyotes affected with this variant of rabies. By year's end, 16 of the 33 confirmed cases (48.4%) within the contingency areas involved coyotes. In addition, analysis of salivary glands from 5 Texas Fox variant positive coyotes by CDC revealed 3 of the 5 coyotes tested had a rabies viral load comparable to those found in south Texas during the canine variant outbreak in coyotes, suggesting the possibility of coyote-to-coyote transmission of this variant in west-central Texas.

ORV PROGRAM 2007

Bait Distribution

For the thirteenth consecutive year, WS participated in bait distribution efforts in south Texas (coyote ORV zone) and for the twelfth year in west-central Texas (gray fox ORV zone); 3,420,981 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 106,462 km^2 (41,106 mi^2) (Figure 1). Since its program inception in 1995, WS has cooperated to distribute over 30 million ORV baits in Texas.

Coyote.--From 5-10 January 2007, WS participated as a member of the ORVP by helping to distribute 729,888 oral rabies vaccine (ORV) baits over 30,783 km^2 (11,885 mi^2) of south Texas (Figure 1). This 59 km (36.5 mi) wide vaccination zone is in place to prevent the re-emergence of canine rabies variant from Mexico. Fixed-wing and rotary aircraft distributed 716,028 fishmeal polymer (FMP) baits across portions of 14 counties, while city employees hand distributed 13,860 FMP baits throughout communities in Cameron, Hidalgo, and Webb Counties. Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), provided the fixed-wing aircraft services and the Texas WS program provided the helicopter. Fishmeal polymer baits contain 150 mg of tetracycline biomarker and a 2 ml sachet of Raboral V-RG® vaccine and they were distributed at a standard rate of 27/km^2 (70 baits/mi^2) throughout the zone.

Gray fox.--From 11-27 January 2007, WS participated in the distribution of 2,342,410 ORV baits over 63,241 km^2 (24,418 mi^2) to contain a variant of rabies unique to gray foxes in west-central Texas (Figure 1). Dynamic Aviation again provided air services and distributed 2,305,398 dog food polymer (DFP) and 35,932 FMP baits via fixed-wing aircraft. Dog food polymer baits also contain 150 mg of tetracycline biomarker and a 2 ml sachet of Raboral V-RG® vaccine. They were distributed at a standard rate of 38.6/km^2 (100 baits/mi^2) throughout the zone, but several different river/riparian corridors were double-baited at 77.2/km^2 (200 baits/mi^2) (Figure 1). In

addition, FMP baits were distributed over 1,082 km^2 (418 mi^2) in the southern portion of the gray fox zone to evaluate the acceptance of this bait type by gray fox (Figure 1). With the baits supplied by WS during 2007, the Texas ORVP cooperative effort was able to bait the remaining affected gray fox rabies epizootic area.

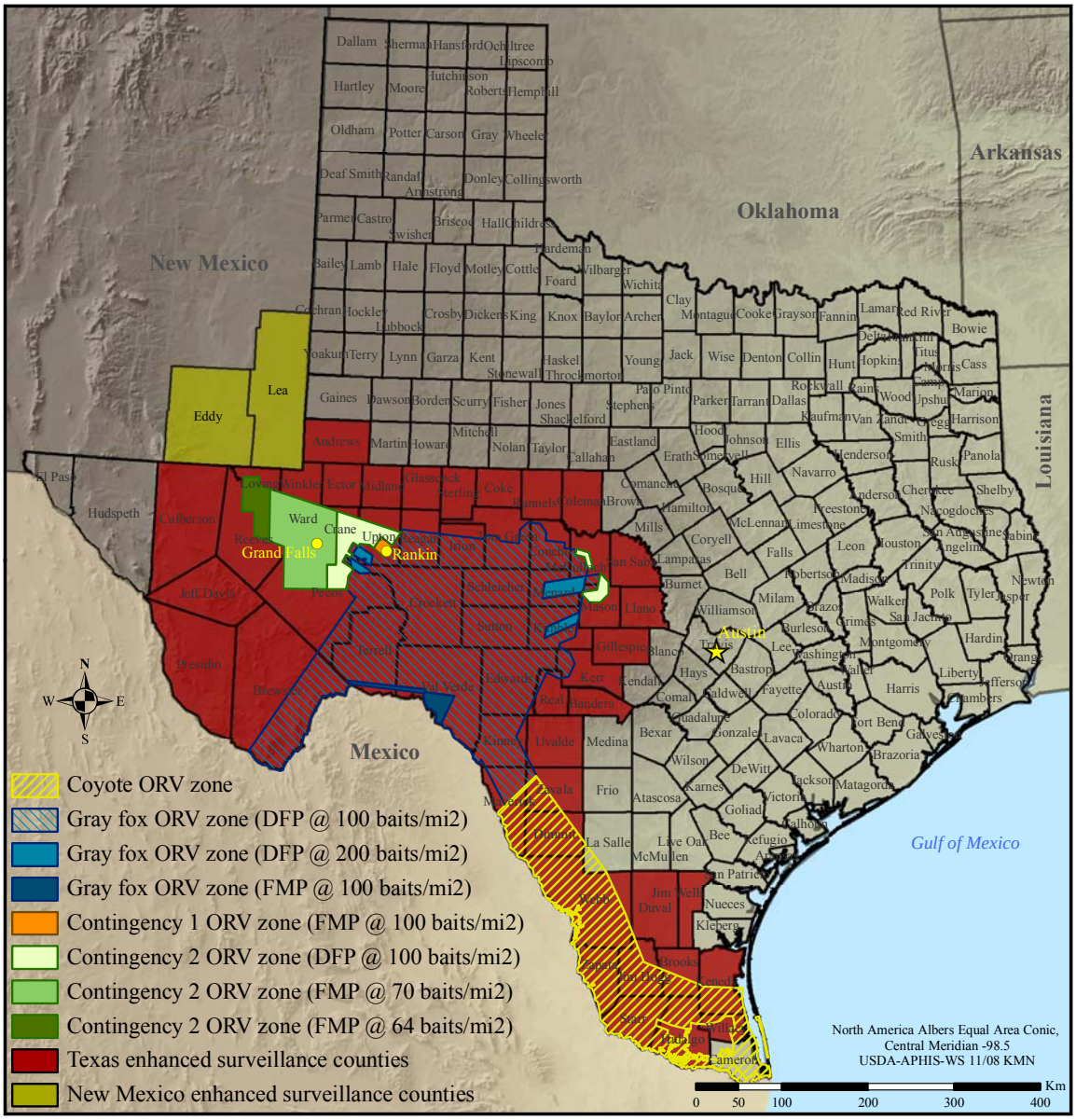

Figure 1. Wildlife Services cooperative rabies management program activities in Texas, 2007.

West-Central Texas Contingencies.--From 12-16 February 2007, WS and TDSHS implemented population reduction efforts within a 259 km^2 (100 mi^2) area surrounding Rankin; 85 animals were removed: 53 bobcats (*Lynx rufus*), 20 gray foxes, 6 coyotes, 3 red foxes (*Vulpes vulpes*), 2 raccoons (*Procyon lotor*), and 1 striped skunk (*Mephitis mephitis*). On 19 February, the Texas WS program provided a helicopter to distribute 8,687 FMP baits (at a rate of 38.6 baits/km^2 [100 baits/mi^2]) over the Rankin contingency area (Figure 1, Contingency 1). By 15 March, an additional 9 cases of the Texas Fox variant of rabies were confirmed in Upton, Crane, Pecos and Ward Counties (3 gray foxes, 3 coyotes, 1 bobcat, 1 domestic dog [*Canis lupus familiaris*], and 1 domestic cat [*Felis catus*]). From 21-25 March, WS and TDSHS used the fixed-wing aircraft services of Dynamic Aviation to distribute 225,360 FMP and 112,476 DFP baits over 12,179 km^2 (4,703 mi^2) (Figure 1, Contingencies 2). In addition, TDSHS, WS and city employees hand distributed 2,160 DFP baits throughout communities within the contingency areas. Fishmeal polymer baits were distributed to contain the rabies outbreak in coyotes across the western two-thirds of this second

contingency area, while DFP baits were distributed in the eastern third of this area to target gray foxes (Figure 1, Contingencies 2) and to increase the barrier width at key points along the eastern edge of the existing gray fox ORV zone. Fishmeal polymer baiting strategies for coyotes included the standard dispersal rate of 27 baits/km^2 (70 baits/mi^2) and a reduced rate of 25.7 baits/km^2 (64 baits/mi^2). The reduced dispersal rate enabled WS and the TDSHS to distribute contingency baits over a larger geographical area and afforded the opportunity to field test the hypothesis that a slight reduction in the dispersal rate would still provide an acceptable level of ORV "herd immunity" in coyotes. Upon completion of the second west-central Texas contingency action the TDSHS and WS increased the size of the enhanced rabies surveillance area to include all counties surrounding the gray fox zone and contingency bait areas (Figure 1).

Enhanced Surveillance

Direct Rapid Immunohistochemistry Test (dRIT)/Direct Fluorescent Antibody Test (dFA).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Texas WS personnel attended dRIT training in October 2005 at the CDC in Atlanta, Georgia and TDSHS personnel attended dRIT training in March 2006 in Laredo, Texas. During 2007, increased surveillance efforts by WS and TDSHS personnel resulted in 1,316 animals sampled and tested for rabies using the dRIT and dFA; 68 tested positive and 1,223 tested negative (Table 1). Twenty-five samples were unable to be tested. Additionally, the New Mexico WS program sampled and submitted for dRIT testing 29 animals from Lea and Eddy Counties. None of the New Mexico samples tested positive for rabies. All positives and 10% of all negatives were sent to the CDC for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS and TDSHS dRIT results. Wildlife Services and TDSHS will continue to use the dRIT and dFA testing in 2008 to enhance surveillance of suspect rabid animals in Texas.

Table 1. Animals tested for rabies by Wildlife Services and the Texas Department of States Health Services using the direct rapid immunohistochemistry test (dRIT) and direct fluorescent antibody test (dFA) in or adjacent to oral rabies vaccination (ORV) counties in Texas, 2007 (rabies positives in parentheses).

County	Coyote	Gray fox	Bobcat	Raccoon	Skunk	Other[a]	Total
Andrews	8						8
Brewster	2						2
Brooks	1						1
Coke				2		1	3
Concho	1	4 (4)		2 (1)	1		8 (5)
Crane	45 (2)	2 (1)	3 (1)	1	2		53 (4)
Crockett				5			5
Culberson	35						35
Duval	17						17
Ector	96		2			1	99
Edwards		4 (2)	2 (1)	1 (1)		1 (1)	8 (5)
Gillespie		2	1	1	1		5
Glasscock	1	2			3 (3)	2	8 (3)
Hidalgo	13						13
Irion		4	1	4			9
Jeff Davis	50	1	3			1	55
Jim Hogg	5						5
Jim Wells	12						12
Kenedy	4						4
Kerr		1	1	8	3	1(1)	14 (1)
Kimble		4 (1)	3	7			14 (1)
Loving	61		1				62
Mason		1 (1)		1			2 (1)
Maverick	5						
McCulloch		12 (5)	7 (1)	3		1	23 (6)
Menard		4 (1)	2 (2)				6 (3)
Midland	22	20	6	5			53
Pecos	104 (7)	13 (1)	8	3	4	6 (2)	148 (10)
Presidio	26		1				27
Reagan	4				1		5
Reeves	235 (5)	3	1				239 (5)
Runnels	1		3				4
San Saba		2					2
Schleicher			1 (1)				1 (1)
Starr	4						4
Sterling			2	2			4
Sutton			1 (1)				1 (1)
Terrell	1	8	2				11
Tom Green		7	2 (1)	2		4	15 (1)
Upton	43	32 (5)	5 (2)	6	3 (1)	2 (1)	91 (9)
Uvalde	2	1	1				4
Val Verde		2 (2)				1 (1)	3 (3)
Ward	53 (5)	1				5 (3)	59 (8)
Webb	20						20
Willacy	2						2
Winkler	87 (1)	3				5	95 (1)
Zapata	35		1				36
Total	995 (20)	133 (23)	60 (10)	53 (2)	18 (4)	32 (9)	1291 (68)

[a] Includes domestic livestock and free-ranging/feral cats and dogs.

Laboratory Cooperation

The ORV program in Texas cooperates with the TDSHS Laboratory (TDSHSL), the DOD-VFADL, and Johnston Biotech (JB) (Sania, Ontario, Canada). The Texas ORVP has had an efficient and cooperative relationship with these laboratories since 1995, and they remain critical to the program's evaluation and surveillance efforts.

Texas Department of State Health Services.--The TDSHSL tests full cross sections of the animal's brainstems plus at least one other section to include cerebellum or hippocampus (preferably all three) for rabies through public health surveillance (specimens involved in a potential or confirmed exposure) and enhanced surveillance testing (samples not involved in an exposure). The TDSHSL received 15,627 brainstem samples for rabies testing; 539 were not able to be tested. Of the 15,088 samples that yielded a result, 969 tested positive for rabies (Table 2) including 482 bats (*Chiroptera* spp.), 362 skunks (*Mephitidae* spp.), 32 foxes, 21 coyotes, 17 raccoons, 14 cats, 12 bobcats, 12 dogs, 9 horses (*Equus caballus*), 4 cattle (*Bos taurus*), 1 opossum (*Didelphis virginiana*), 1 pig (*Suidae* spp.), 1 goat (*Capra aegagrus hircus*), and 1 wolf-hybrid (*Canis* spp.). Samples were submitted from 241 of 254 counties throughout the state. Forty samples were submitted as part of enhanced rabies surveillance efforts. For detailed information on rabies in Texas, please visit: http://www.dshs.state.tx.us/idcu/disease/rabies/

Table 2. Animal brainstem samples testing positive for the rabies virus (n=969) by the Texas Department of State Health Services Laboratory via the public health and enhanced surveillance systems (includes all rabies virus variants) in Texas, 2007 (percent of total rabid animals in parentheses).

Species	Within coyote ORV[a] zone	Within gray fox ORV zone	Within contingency ORV zones	Remainder of State
Bats	20 (2.1%)	1 (0.1%)	0	461 (47.6%)
Skunks	0	7 (0.7%)	2 (0.2%)	353 (36.4%)
Foxes	0	18 (1.9%)	6 (0.6%)	8 (0.8%)
Coyotes	0	0	16 (1.7%)	5 (0.5%)
Raccoons	0	2 (0.2%)	0	15 (1.5%)
Bobcats	0	8 (0.8%)	2 (0.2%)	2 (0.2%)
Opossum	0	0	0	1 (0.1%)
Other[b]	0	6 (0.6%)	7 (0.7%)	29 (3.0%)
Total	20 (2.1%)	42 (4.3%)	33 (3.4%)	874 (90.2%)

[a] ORV=oral rabies vaccination.
[b] Other includes: cats, dogs, horses, cattle, pig, goat, and wolf-hybrid.

Department of Defense Veterinary Food Analysis and Diagnostic Laboratory.--The DOD-VFADL analyzes wildlife serum samples (submitted by the TDSHS and WS) for levels of rabies virus neutralizing antibodies (VNA). The DOD-VFADL analyzed 392 serum samples for rabies VNA in 2007, representing a 13.1% increase from the 339 samples submitted in 2006. Both the TDSHS and WS anticipate an increase in the number of submissions in 2008.

Johnston Biotech.--Johnston Biotech analyzes coyote and gray fox teeth submitted for age and the presence of tetracycline biomarker. In 2007, JB analyzed 344 tooth samples, representing a slight increase in the number of samples submitted from 2006. The number of submissions in 2008 is expected to decrease.

ORV PROGRAM 2007 – EVALUATION

Annual evaluations of the ORVP are based on 3 criteria: 1) the detection of the tetracycline biomarker in dental tissue which can be used to demonstrate the number of baits eaten in a given year and the annual bait consumption by animals over a period of multiple years. However, inaccuracies happen because older animals do not deposit the biomarker and the presence of tetracycline does not confirm that the vaccine sachet has been punctured or consumed; 2) the number of positive rabies antibody responses from animals collected within the vaccination zone (at ≥0.05 IU); and 3) the epidemiology of rabies cases in the target area. All biological samples collected to evaluate the success of the ORVP were obtained from targeted animals. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done

so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations. The 2007 Texas ORV bait distribution occurred in January (with contingency baiting occurring in February and March) and 2007 program evaluation data (serology, tetracycline, and age results) were available at the time of this report.

Serology, Tetracycline Biomarker, and Age Results

Coyote.--In 2007, TDSHS and WS collected 120 coyotes for ORVP evaluation from within the south Texas vaccination zone. Fifty-nine of 120 coyotes tested (49.2%) within the ORV zone showed a positive rabies antibody response to the vaccine, while 112 of 120 coyotes tested (93.3%) were positive for the tetracycline biomarker included in the bait material (Figure 2). Since the initiation of the ORVP in south Texas, canine rabies cases have declined from 122, reported during the pre-program year in 1994, to 0 in 2000. During 2001 and again in 2004, a single canine rabies case involving an unvaccinated dog and a dog with unproven vaccination, respectively, was confirmed in Laredo, Texas. Both isolated cases occurred within 1 mile of the U.S.-Mexico border. In response, the City of Laredo Health Department's Animal Control Division implemented an aggressive isolation and vaccination protocol. Additional control measures included increased vaccination clinics for domestic pets throughout the city. No additional cases have been reported since 2004 and the CDC and World Health Organization (WHO) declared the United States free of canine rabies in 2007. Public health and enhanced surveillance is being used to monitor the area until ORV baits are applied in January 2008.

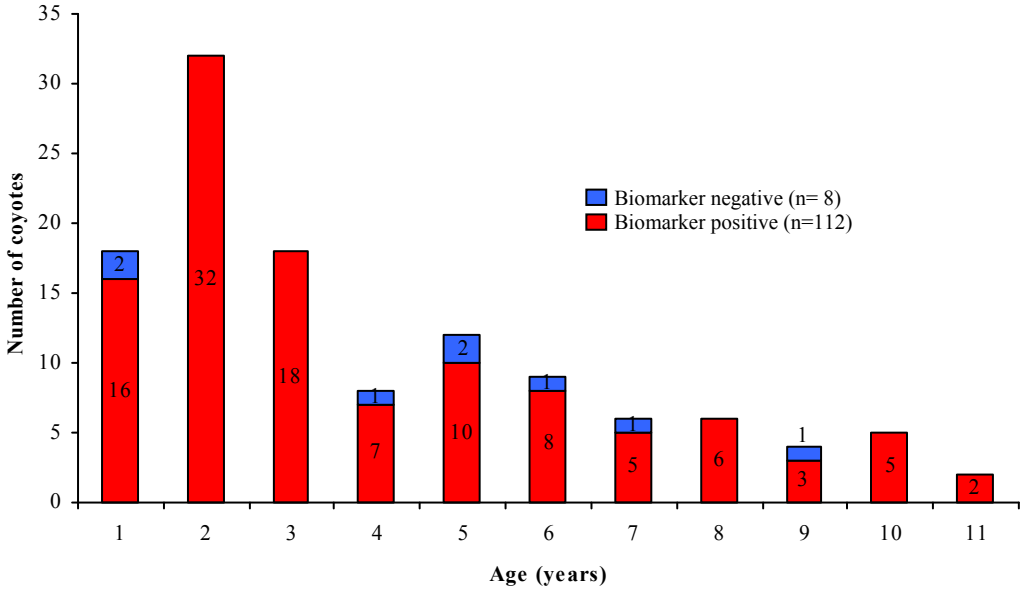

Figure 2. Age class distribution and presence/absence of tetracycline biomarker for 120 coyotes collected during post-bait oral rabies vaccination program evaluation in the coyote zone of south Texas, 2007.

Gray fox.--In 2007, the number of rabies cases involving the Texas Fox variant increased to 62 from the 45 cases reported during 2006. This increase is attributable to an outbreak of this rabies variant in far west-central Texas. Despite this increase, the total number of cases reported for 2007 remained well below the pre-program high of 244 cases reported in 1995. During the evaluation phase of the 2007 gray fox ORVP in west-central Texas, WS and the TDSHS collected 138 gray foxes. Blood and tooth samples were taken from all gray foxes as well as 18 coyotes, 10 striped skunks, 4 bobcats, 2 raccoons, and 1 ringtail (*Bassariscus astutus*). Overall, 114 of 173 animals (65.9%) demonstrated a positive rabies VNA response, while 94 of 173 animals (54.3%) showed the presence of tetracycline biomarker (Table 3).

Table 3. Serology and tetracycline biomarker results of biological samples collected during post-bait oral rabies vaccination program evaluation in the gray fox zone of west-central Texas, 2007 (dog food polymer and fishmeal polymer baits combined).

Species	Positive rabies VNA[a] response	Presence of tetracycline biomarker
Gray fox (n=138)	102 (73.9%)	84 (60.9%)
Coyote (n=18)	9 (50.0%)	4 (22.2%)
Striped skunk (n=10)	3 (33.3%)	5 (50.0%)
Bobcat (n=4)	0	0
Raccoon (n=2)	0	1 (50.0%)
Ringtail (n=1)	0	0
Total (n=173)	114 (65.9%)	94 (54.3%)

[a] VNA=virus neutralizing antibody (≥0.05 IU).

In the DFP area of the gray fox ORV zone 78 of 113 gray foxes (69.0%) showed a positive rabies antibody response to the vaccine, while 64 of 113 gray foxes (56.6%) were positive for tetracycline biomarker; 100 of the 113 gray foxes were aged (Figure 4). In the FMP area 24 of 25 gray foxes (96.0%) showed a positive antibody response to the vaccine, while 20 of 25 gray foxes (80.0%) were positive for the tetracycline biomarker (Figure 3). While the serology and biomarker results with FMP baits are promising, further field evaluation of acceptance by gray foxes is needed. Public health and enhanced surveillance is being used to monitor the area until ORV baits are applied in January 2008.

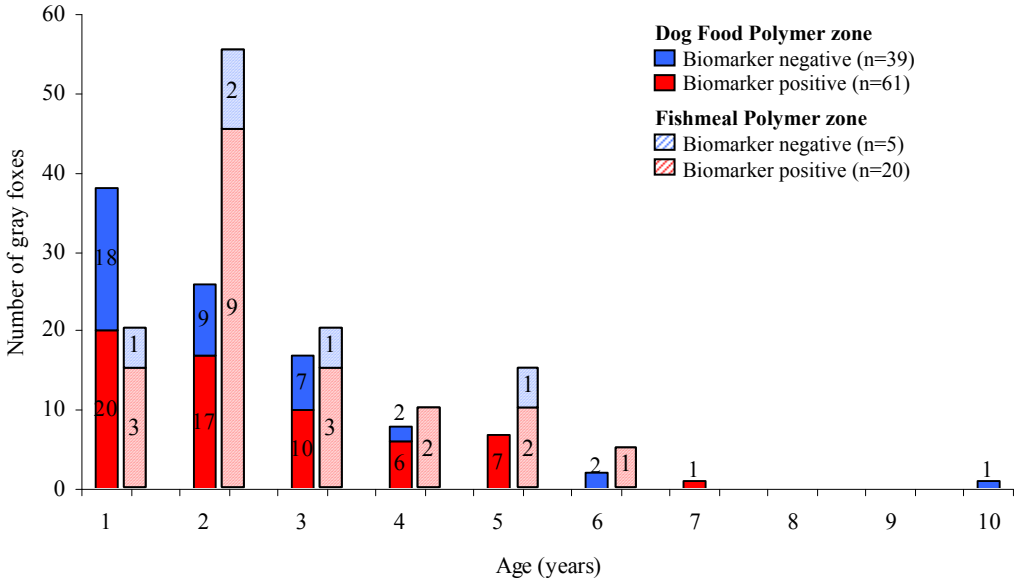

Figure 3. Age class distribution and presence/absence of tetracycline biomarker for 125 gray foxes collected during post-bait oral rabies vaccination program evaluation in the gray fox zone of west-central Texas, 2007.

West-Central Texas Contingencies.--During the evaluation phase of the 2007 west-central Texas contingency zones, WS and the TDSHS sampled 98 coyotes for analysis within the standard DFP (38.6 baits/km^2) and FMP (27 baits/km^2) areas as well as the FMP reduced bait density area (25.7 baits/km^2). Blood samples were taken from all coyotes and tooth samples from 50 coyotes. No tooth samples were taken from the reduced FMP bait density area. In addition, samples were taken from 1 gray fox in the reduced FMP bait density area. Overall, 33 of 99 animals (33.3%) demonstrated a positive rabies VNA response, while 17 of 51 animals (33.3%) tested for biomarker showed the presence of tetracycline (Table 4).

Table 4. Serology and tetracycline biomarker results of biological samples collected during post-bait oral rabies vaccination program evaluation in the west-central Texas contingency zones, 2007.

Bait Type	Bait density km^2 (mi^2)	Species	Positive rabies VNA[a] response	Presence of tetracycline biomarker
DFP (n=20)	38.6 (100)	Coyote	5 (20%)	2 (10%)
FMP (n=30)	27 (70)	Coyote	10 (33.3%)	15 (50%)
FMP (n=1)	27 (70)	Gray fox	0	0
FMP (n=48)	25.7 (64)	Coyote	18 (37.5)	n/a[b]
Total (n=99)			33 (33.3%)	17 (33.3%)

[a] VNA=virus neutralizing antibody (≥0.05 IU).
[b] No tooth samples taken.

The 2007 post-bait serology and biomarker results of coyotes within the contingency zones were lower than in the south Texas zone, but coyotes require multiple doses of ORV to achieve a higher level of herd immunity. The 2007 evaluation results are very comparable to those obtained in south Texas during the initial years of the ORVP and suggest an acceptable level of herd immunity for coyotes might be achieved with a reduced FMP bait density. Public health and enhanced surveillance of these contingency areas and adjacent counties is being used to monitor the areas until ORV baits are applied in January 2008.

SUMMARY

Since 1995, 12.31 million ORV baits have been distributed over south Texas by the coyote ORVP. This has proved to be highly effective in the elimination of the canine variant of rabies in that area, leading to a declaration of canine rabies-free status in the United States in 2007. A barrier strategy has been developed to sustain a zone of immunized wildlife along the Texas-Mexico border with only two incursions into the zone at Laredo since 2001, thus preventing the re-emergence of the variant. This strategy, and the south Texas coyote ORVP, will continue in 2008.

Early in 2007, the Texas cooperative ORVP program observed an outbreak of the Texas Fox variant of rabies in far west-central Texas (west of the then current gray fox ORV zone). The high number of coyotes affected with this rabies variant and the possibility of coyote-to-coyote transmission further complicated this outbreak. Contingency actions were immediately implemented via local population reduction of rabies vector species, additional ORV bait distribution, and enhanced rabies surveillance throughout the entire outbreak area. These contingencies, as a component of the west-central Texas gray fox ORVP, are expected to continue in 2008.

In spite of this recent outbreak, the cooperative ORVP in west-central Texas has been successful in reducing (by more than half) the size of the gray fox epizootic from 186,554 km^2 (72,029 mi^2) in 1996 to approximately 88,098 km^2 (34,015 mi^2) by 2007. With continued support for the cooperative ORVP effort, ongoing success with the gray fox epizootic is expected in west-central Texas where 19.28 million ORV baits have been distributed since 1996.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
VERMONT 2007

BACKGROUND

In 1994, the raccoon (*Procyon lotor*) variant of the rabies virus was first confirmed in several Vermont towns on the Massachusetts border. In less than 2 years, raccoon rabies had spread north through 8 counties in Vermont and by May 1996 was just south of Burlington, Vermont's largest city, approximately 70 km (42 miles) south of the U.S.-Canada border (Figure 1). One year later, on 5 May 1997 an intensive oral rabies vaccination (ORV) program was initiated to prevent further northward spread of raccoon rabies up the Lake Champlain Valley into Quebec, Canada. The initial ORV zone encompassed 1,637 km^2 (632 mi^2) in northwestern Vermont including all of Franklin County and portions of Chittenden and Grand Isle Counties. This area was baited the following year, as well as 556 km^2 near Lyndonville in response to a rabid skunk (*Mephitis mephitis*) confirmed in the town to the south. In 1999, 2 rabid raccoons were confirmed just south of Newport and the ORV zone was doubled in size to include the Lake Memphremagog basin (south to Lyndonville). In 2000, the ORV zone was expanded again along the Connecticut River Valley in Essex County in response to 2 rabid raccoons from 1999: 1 on each side of the river (state border with New Hampshire). In 2001, a rabid skunk just south of Newport was confirmed and was the northernmost case of raccoon variant at the time, approximately 16 km (9.6 mi) south of the international border. Over the next 5 years, no cases of raccoon rabies were confirmed within 35 km (21 mi) of the U.S.-Canada border. In June 2006 however, Quebec confirmed its first-ever case of raccoon rabies in Dunham, approximately 11 km (6.6 mi) north of the Vermont border (Figure 1). Wildlife Services (WS) responded by enhancing rabies surveillance and conducting a small-scale trap-vaccinate-release (TVR) effort. In 2007, surveillance was increased significantly, coordinated TVR was implemented on a broad scale, and ORV baits were distributed at double density along the border.

Since its inception, the Vermont ORV program has been a cooperative effort between Wildlife Services (WS), Cornell University (CU), the Vermont Departments of Health (VDH) and Fish and Wildlife (VTFW), the Vermont Agency of Agriculture, Food, and Markets (VTAG), the Ontario Ministry of Natural Resources (OMNR), and the Province of Quebec. Wildlife Services has been the major source of federal funds for program implementation. Wildlife Services has also provided federal wildlife management leadership by continuing to play an active role in: program planning and coordination; organizing ground support for aerial bait distribution; working in and navigating aircraft to distribute baits; coordinating the hand distribution of baits in areas too populated to bait by air; enhancing rabies surveillance by collecting suspect rabid animals; and evaluating program efficacy by monitoring post-ORV rabies virus neutralizing antibody (VNA) levels and bait uptake (when appropriate) in raccoons.

ORV PROGRAM 2007

Bait Distribution

For the eleventh consecutive year, WS participated in bait distribution efforts in northern Vermont; 421,179 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 9,168 km^2 (3,540 mi^2) in 2007 (Figure 1). Two new low bait density zones were added in 2006, one each in Addison and Washington Counties (each 250 km^2 in size). These low density (35 baits/km^2) areas were repeated in 2007 and will be compared to the standard density (70 baits/km^2) for the Vermont ORV zone. In addition, baits were distributed at high density (140 baits/km^2) in a swath 4.5 km (2.7 mi) wide for 130 km (78 mi) along the length of most of the Vermont-Quebec border.

From 7-9 August, 412,219 fishmeal-coated sachet (CS) baits were distributed over 9 counties: Addison, Caledonia, Chittenden, Essex, Franklin, Grand Isle, Lamoille, Orleans, and Washington. Fixed-wing aircraft were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS personnel served as navigators and flight crew in the planes. Ground support for aerial baiting was provided by WS, Dynamic, and CU. Also from 7-9 August, WS distributed 8,960 fishmeal polymer (FMP) baits via ground operations (hand/truck baiting) in 26 small cities and villages. Since its program inception in 1997, WS has cooperated to distribute 2,977,460 ORV baits in Vermont.

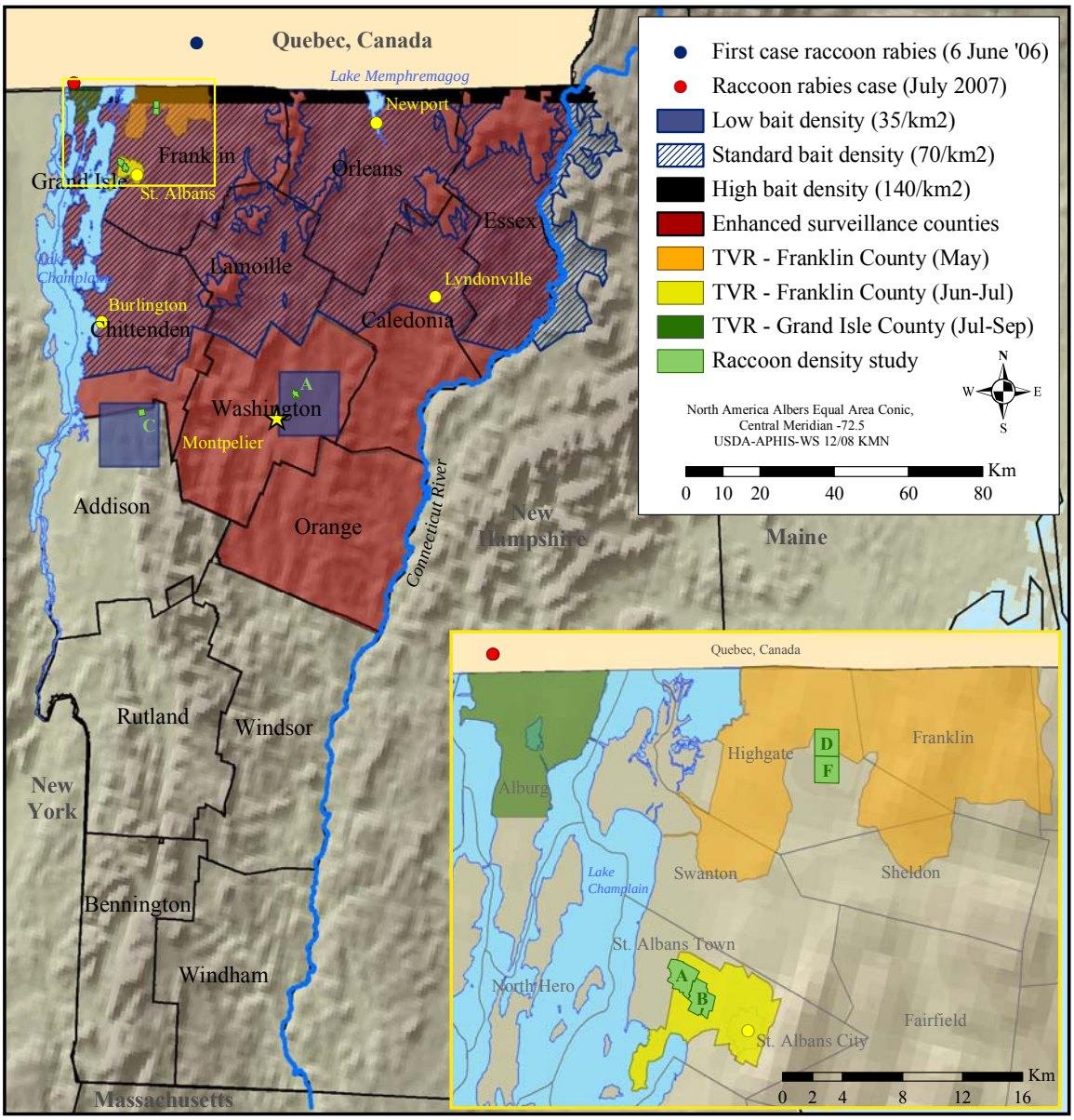

Figure 1. Wildlife Services cooperative rabies management program activities in Vermont, 2007.

Enhanced Surveillance

In response to the Quebec case in 2006, Vermont WS and cooperators increased enhanced rabies surveillance activities, in the northern part of the state by establishing or renewing relations with the Vermont Agency of Transportation, VTFW Game Wardens, State Police, US Border Patrol, municipal officials, and area landowners. Enhanced rabies surveillance focuses on road killed, strange acting, and nuisance animals not involved in an exposure that may otherwise not be tested through the public health surveillance system. In 2007, WS increased enhanced rabies surveillance significantly in the northern part of the state by collecting and submitting 705 animals (compared to 139 in 2006). Three samples were indeterminate due to decomposition and 106 (15.0%) tested positive for rabies (Table 1).

Table 1. Animals collected and submitted by Wildlife Services to enhance rabies surveillance in Vermont, 2007 (rabies positives in parentheses).

County	Raccoon	Skunk	Red fox	Coyote	Woodchuck	Other[a]	Total
Caledonia	11 (7)	3 (3)	2				16 (10)
Chittenden	10 (4)	7 (5)				1	18 (9)
Essex	1						1
Franklin	231[b] (60)	106[b] (9)	9 (1)	3	3	9 (1)	361 (71)
Grand Isle	174 (10)	26 (1)	1	1		1	203 (11)
Lamoille	9 (2)	7 (1)	3				19 (3)
Orange[c]			1 (1)				1 (1)
Orleans	58[b]	23	1	2			84
Washington				1	1 (1)		2 (1)
Total	494 (83)	172 (19)	17 (2)	7	4 (1)	11 (1)	705 (106)

[a] Other animals included: 5 cats (in Franklin), 2 fishers (1 in Chittenden; 1 in Grand Isle), 2 opossums (in Franklin), and 2 sheep (in Franklin; 1 positive).
[b] One sample was indeterminate due to decomposition.
[c] Oral rabies vaccine not applied in this county.

The animals collected by WS included various collection methods and fates; 378 were directly euthanized by WS and 327 were found dead or collected from landowners who had euthanized them. Animals were euthanized because they exhibited abnormal behavior, presented with lesions, or were nuisances to landowners. Of the animals found dead by WS, 154 were road kills and 17 were confirmed rabid. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Vermont WS personnel attended dRIT training in May 2005 at the Centers for Disease Control and Prevention in Atlanta, Georgia. Currently, the VDH is meeting enhanced surveillance testing needs; however, WS plans on implementing the dRIT in the future as needed.

Coordinated TVR

In a continuing effort to stop the spread of raccoon rabies in northern Vermont, WS implemented several TVR campaigns throughout the standard and high bait density ORV zones in 2007 (Figure 1). By year's end, 1,226 animals (unique to a given sampling period) were trapped, vaccinated, and released (Table 2).

Table 2. Animals trapped, vaccinated, and released by Wildlife Services in Vermont, 2007.

	Franklin Co. TVR (May)[a]	Franklin Co. TVR (June-July)	Grand Isle Co. TVR	Post-ORV TVR	Total
Raccoons	587	103	205	256	1,151
Cats (feral/free-ranging)	40	5	9	5	59
Red foxes	3	5	2		10
Fishers	2		1	2	5
Coyotes			1		1
Total	632	113	218	263	1,226

[a] One raccoon was trapped, vaccinated, and released on 30 April prior to the start of coordinated TVR, but has been included here.

Franklin County, May.--Ten WS personnel from Maine, Maryland, Massachusetts, New Hampshire, New York, and Vermont conducted a Coordinated TVR effort from 8-23 May 2007 in Franklin County (Figure 1). Cage traps were used to capture 653 unique raccoons and 40 skunks. All skunks were euthanized to better understand the role that they may have played in the outbreak; 36 were submitted to the VDH and all were negative for rabies. Sixty-five raccoons were euthanized after exhibiting disorientation, having puncture wounds/bite marks or other lesions, or showing clinical signs of rabies; 61 were submitted to the VDH and 7 were positive for rabies including 2 with porcupine quills in their rostrums. In addition, 2 raccoons were found dead in cage traps and submitted; one tested positive for rabies. The remaining 586 raccoons were hand vaccinated with 1 ml of Imrab3® rabies vaccine (Merial Limited) and released. Three of these raccoons were euthanized upon recapture due to abnormal behavior and 1 tested positive for rabies; it had been caught, vaccinated and released 4 days prior to being recaptured and euthanized. Additionally, 40 feral/free-ranging cats (*Felis catus*), 3 red foxes (*Vulpes vulpes*), and 2 fishers (*Martes pennanti*), were hand vaccinated and released. Most of the raccoons and skunks, and the 2 fishers, were immobilized and processed as normal (blood and tooth samples collected) to evaluate ORV efficacy from the previous year's baiting (August 2006).

Franklin County, June-July.--From 4 June to 20 July, 5 Vermont WS personnel continued the TVR campaign in the same area of Franklin County that was trapped in May, as well as in and around the city of St. Albans (Figure 1). Cage traps were used to capture 116 raccoons unique to this sampling period (although 3 of them had been previously captured during TVR efforts in May). Ten raccoons were euthanized; 8 were submitted to the VDH and 1 was positive for rabies. Of the remaining 106 raccoons, all but the 3 recaptures were hand vaccinated and released. Six skunks were also trapped and euthanized; 4 were submitted to the VDH and all were negative for rabies. Additionally, 5 feral/free-ranging cats and 5 red foxes were hand vaccinated and released. Two more red foxes were euthanized due to abnormal behavior or human exposure; they both tested negative for rabies. Approximately half of the animals were immobilized and processed as normal (blood and tooth samples collected) to evaluate ORV efficacy from the previous year's baiting (August 2006).

Grand Isle County, July-September.--In July, raccoon rabies was documented in Quebec, just north of Grand Isle County, Vermont (Figure 1). This prompted a shift in TVR priorities from Franklin to Grand Isle County and to vaccinating and releasing animals without processing. Efforts continued with 3 Vermont WS personnel from 24 July to 21 September in Grand Isle County. Cage traps were used to capture 318 raccoons unique to this sampling period (although 5 of them had been previously captured during earlier TVR efforts). One hundred eight raccoons were euthanized; 107 were submitted to the VDH and 4 were positive for rabies. Of the remaining 210 raccoons, all but the 5 recaptures were hand vaccinated and released. Nine of these 205 raccoons were captured again during the same sampling period (1-20 days after their original capture). All 9 were euthanized upon recapture due to abnormal behavior and all tested negative for rabies. Seventeen skunks were also trapped and euthanized; 16 were submitted to the VDH and all were negative for rabies. Additionally, 9 feral/free-ranging cats, 2 red foxes, 1 coyote (*Canis latrans*), and 1 fisher were hand vaccinated and released. One more red fox was euthanized due to abnormal behavior; it tested negative for rabies. Approximately 10% of the animals were immobilized and processed as normal (blood and tooth samples collected) to evaluate ORV efficacy from the previous year's baiting (August 2006).

Post-ORV Trapping.--During post-ORV trapping throughout the standard and high bait density ORV zones (which included July and September raccoon density studies), animals were also hand vaccinated opportunistically. Eight WS personnel from Illinois, Maine, and Vermont used cage traps to capture 315 raccoons unique to the post-ORV sampling period (although 33 of them had been previously captured during TVR efforts from May-July 2007). Of the 315, 26 were euthanized; 22 were submitted to the VDH and 2 were positive for rabies. Of the remaining 289 raccoons, all but the 33 recaptures were hand vaccinated and released. Fifty-three skunks were also captured and 52 were euthanized; 25 were submitted to the VDH and 1 tested positive for rabies. The 1 skunk that was released did not receive a hand vaccination. Additionally, 5 feral/free-ranging cats and 2 fishers were hand vaccinated and released. Most of the raccoons and skunks, and the 2 fishers, were immobilized and processed as normal (blood and tooth samples collected) to evaluate ORV efficacy from baiting in August 2006 and 2007.

Population Monitoring

In 2007, WS conducted 10 raccoon density studies: 1 each in Addison and Washington Counties, and 8 in Franklin County (Figure 1). The National Rabies Management Program (NRMP) standard protocol of 50 cage traps

set on a target study area of 3 km^2 (1.2 mi^2) for 10 consecutive nights was used for the Addison and Washington County studies, while traps were set for 15 consecutive nights in the Franklin County studies.

The Addison and Washington County studies were conducted in the low ORV bait density zones and were replicated on 2 of the same sites as in 2006 (when 4 studies were conducted, 2 in each county). Studies in 2007 were conducted at approximately the same time of year as in 2006 and raccoon densities were similar to 2006 (Table 3).

Table 3. Index to raccoon densities in Addison and Washington Counties, Vermont, 2006-2007.

	2006 Washington-A	2007 Washington-A	2006 Addison-C	2007 Addison-C
Time of study	25 Sep.-5 Oct.	5-15 Sep.	25 Sep.-5 Oct.	5-15 Sep.
Macrohabitat	Agriculture	Agriculture	Agriculture	Agriculture
Target trap nights	500	500	500	500
Unique raccoons	12	17	14	17
Recaptured raccoons	3	6	5	10
Non-target captures[a]	21	29	14	2
Area (km^2)	3.34	3.34	3.16	3.16
Raccoon density index[b]	3.6	5.1	4.4	5.1

[a] May include non-target captures and traps that were otherwise unavailable to capture a raccoon (sprung, stolen, etc.).
[b] Unique raccoons/km^2.

In 2007, Vermont was selected (alongside Alabama and Pennsylvania) to perform paired 15-day density studies, replicated 30 days apart, to continue to test the NRMP's "high density protocol" for indexing raccoons (50 cage traps set on a target study area of 3 km² for 15 consecutive nights). Four studies were conducted prior to annual ORV (2 each in Highgate and St. Albans) and the studies were replicated 30 days later (post-ORV distribution). The studies were conducted in agricultural areas representative of habitat found throughout the standard bait density ORV zone (Figure 1 and inset). All 4 study areas had been treated with ORV since 1997. Density studies had been previously conducted on the Highgate study sites from 2001-2003, and from 2004-2005 on the St. Albans sites (all as efforts to assess the validity of the NRMP's density estimation protocols).

During the first 2 pairs of studies in July, 93 unique raccoons were captured: 50 in Highgate and 43 in St. Albans (Table 4). During the second 2 pairs of studies in September, 51 raccoons were captured that were unique to that sampling period: 21 in Highgate and 30 in St. Albans. Twenty-nine of the 51 raccoons had been previously captured during the first sampling period: 12 in Highgate and 17 in St. Albans. Blood and tooth samples were collected from most of the unique raccoons in both sampling periods (July and September) and many raccoons were hand vaccinated prior to release to bolster the immunity of the populations (Table 4).

Table 4. Index to raccoon densities in Franklin County, Vermont, 2007.

	Highgate				St. Albans			
	D1	F1	D2	F2	A1	B1	A2	B2
Time of study	17 July-1 August		5-20 September		17 July-1 August		5-20 September	
Weeks post-ORV	47-49		4-6		47-49		4-6	
Macrohabitat	Agriculture		Agriculture		Agriculture		Agriculture	
Target trap nights	750	750	750	750	750	750	750	750
Unique raccoons	21	29	9[a]	12[b]	13	30	7[c]	23[d]
Recaptured raccoons	5	23	1	4	6	46	2	23
Non-target captures[e]	2	46	27	51	22	5	8	8
Area (km^2)	2.87	2.84	2.87	2.84	3.06	3.17	3.06	3.17
Raccoon density index[f]	7.3	10.2	3.1	4.2	4.2	9.5	2.3	7.3

[a] Five raccoons were captured in the first period of studies, but were unique to the second period of studies.
[b] Seven raccoons were captured in the first period of studies, but were unique to the second period of studies.
[c] Three raccoons were captured in the first period of studies, but were unique to the second period of studies.
[d] Fourteen raccoons were captured in the first period of studies, but were unique to the second period of studies.
[e] May include non-target captures and traps that were otherwise unavailable to capture a raccoon (sprung, stolen, etc.).
[f] Unique raccoons/km^2.

Post-ORV Monitoring

Post-ORV sampling for the standard and high bait density ORV zones (not including density studies mentioned above) was conducted from 25 September to 17 October (7-10 weeks after baiting). Wildlife Services live-trapped 160 unique raccoons and 19 skunks during this evaluation phase. Blood and tooth samples were collected from most of these animals and most of the raccoons were vaccinated prior to release (see *Post-ORV Trapping* in Coordinated TVR section).

Non-target Captures

Non-target (not processed, sampled, or vaccinated) animals captured and released by WS in 2007 included: 59 red squirrels (*Tamiasciurus hudsonicus*), 27 domestic cats, 13 woodchucks (*Marmota monax*), 3 fishers, 4 opossums (*Didelphis virginiana*), 3 mink (*Mustela vison*), 3 muskrats (*Ondatra zibethicus*), 2 gray squirrels (*Sciurus carolinensis*), 2 red-winged blackbirds (*Agelaius phoeniceus*), 2 ruffed grouse (*Bonasa umbellus*), 1 American bittern (*Botaurus lentiginosus*), 1 domestic dog (*Canis lupus familiaris*), 1 rabbit (*Sylvilagus audubonii*), 1 snapping turtle (*Chelydra serpentina*), 1 weasel (*Mustela erminea*), and 1 unknown song bird (*Passeriformes* spp.).

Non-target animals captured and found dead in cage traps by WS in 2007 included 7 red squirrels and 1 Norway rat (*Rattus norvegicus*).

Rabies Laboratory Cooperation

Wildlife Service cooperates with the VDH Laboratory (VDHL) and the New York State Department of Health's Rabies Laboratory at the Wadsworth Center (WC). Wildlife Services has had an efficient and cooperative relationship with both laboratories since 1997, and they remain critical to the surveillance and monitoring phases of the ORV program in Vermont.

Vermont Department of Health Laboratory.--The VDHL tests animal brainstems for rabies via routine public health surveillance throughout the state (specimens involved in a potential or confirmed exposure usually submitted by game wardens, WS, veterinarians, and the public). The VDHL also tests animals to enhance rabies surveillance in counties in or adjacent to the ORV zones (specimens not involved in an exposure and usually submitted by WS). The VDHL tested 1,028 animals for the rabies virus in 2007 (Table 5), representing a 117% increase from 2006. Animals were submitted from all 14 counties throughout the state, including the ORV counties. Of the raccoons tested statewide by the VDHL, 511 came from a county treated with ORV. The VDHL confirmed 165 rabid animals in 2007 from 12 counties: 103 raccoons, 49 striped skunks, 3 big brown bats (*Eptesicus fuscus*), 3 red foxes, 2 domestic/feral cats, 1 bobcat (*Lynx rufus*), 1 cow (*Bos taurus*), 1 horse (*Equus caballus*), 1 sheep (*Ovis aries*), 1 woodchuck (*Marmota monax*). All terrestrial animals had the raccoon variant of rabies.

Raccoons, skunks, foxes, coyotes, and bobcats are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected and submitted by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of primary interest to public health agencies. Due to significantly increased surveillance submissions by WS in 2007, only 22.4% of the statewide samples are reported by WS as "other" and not from these 5 carnivore species. For a full listing of rabid animals in Vermont by town, county and species from 2002 to the present please visit: http://healthvermont.gov/prevent/rabies/Rabies.aspx

Table 5. Animals tested for rabies by the Vermont Department of Health Laboratory in Vermont, 2007 (rabies positives in parentheses).

	Statewide	Within ORV counties
Raccoons	545 (103)	512 (95 or 92.2%)
Skunks	219 (49)	97 (36 or 73.5%)
Foxes	23 (3)	19 (2 or 66.7%)
Coyotes	8 (0)	7 (0)
Bobcats	3 (1)	0
Other[a]	230 (9)	62 (2 or 22.2%)
Total	1,028 (165)	697 (135 or 81.8%)

[a] Other animals included: bats, cats, dogs, other domestic pets, and woodchucks.

New York State Department of Health's Rabies Laboratory at the Wadsworth Center.--The WC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies VNA. In 2007, Vermont WS collected 1,307 blood samples (from 1,187 raccoons, 115 skunks, 4 fishers and 1 red fox) and submitted 1,118 serum samples for rabies VNA analysis to the WC. This represented a significant increase from the 249 samples submitted by WS in 2006. Vermont WS anticipates 200-300 serum sample submissions to this laboratory in 2008. For more information about the Rabies Laboratory at the WC please visit: http://www.wadsworth.org/rabies/

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and teeth are analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain a biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

Serology.--In 2007, WS live-trapped 1,523 raccoons (unique to a given trapping period) and collected samples from most of them (Table 6); 42 were recaptures that had been previously trapped in 2007 during a different sampling period. Samples were taken from 13 of them upon recapture (Table 6 *footnote b*). Samples were also taken from 2 raccoons that were recaptured during the same sampling period that they were originally captured in (Table 6 *footnote a*).

From 21 February through 8 August, WS conducted trapping activities that included enhanced surveillance, coordinated TVR, and raccoon density studies in Franklin County. All of this trapping occurred prior to ORV distribution in 2007, but after ORV distribution from 2006. Sera were collected from 760 raccoons (including 5 with a prior record of hand vaccination) and 29.7% demonstrated a positive rabies antibody response (Table 6). Of the 5 previously vaccinated raccoons, 3 had detectable rabies antibodies when recaptured in 2007: 1 was vaccinated by WS 2 weeks prior in 2007; 1 by Quebec in 2006; and 1 by WS in 2000. One of the vaccinated raccoons that did not sero-convert was vaccinated in 2000 and the other was only vaccinated 1 day prior to recapture in 2007.

From 5-15 September, WS conducted trapping activities in the low bait density zone that included density studies conducted in Addison and Washington Counties. This trapping occurred 4-5 weeks post-2007 ORV. Sera were collected from 33 raccoons and 3.0% had detectable rabies VNA (Table 6). This was down from a 21.7% response in 2006.

From 9 August through 21 October, WS conducted trapping activities in the standard bait density zone, 0-10 weeks following 2007 ORV distribution (bait distribution concluded on 9 August). Trapping included coordinated TVR, September density studies in Franklin County, and regular Post-ORV monitoring. Sera were collected from 190 raccoons (including 13 with a record of hand vaccination 7-13 weeks prior) and 26.8% demonstrated a positive rabies antibody response (Table 6). Of the 13 previously vaccinated raccoons, all had detectable rabies antibodies when recaptured in 2007. One of those 13 had serum collected the first time it was trapped in 2007 and it had antibodies at that time as well.

From 1-4 October, WS conducted trapping activities in the high bait density zone along the U.S.-Canada border. This trapping occurred 8 weeks post-2007 ORV. Sera were collected from 5 raccoons and 20.0% had detectable rabies VNA (Table 6). This was the first year since 2000 that double baiting had occurred in Vermont. In 2000, 17 of 59 raccoons (28.8%) had a rabies antibody response 4-9 weeks following bait distribution at 140 baits/km^2.

Table 6. Serology results of raccoon biological samples collected by Wildlife Services during cooperative rabies management trapping activities in Vermont, 2007.

	Trapping Prior to 2007 ORV	Post-2007 ORV Low Bait Zone	Post-2007 ORV Standard Bait Zone	Post-2007 ORV High Bait Zone	Total
Sample collection timeframe	21 Feb.-8 Aug.	5-15 Sep.	9 Aug.-21 Oct.	1-4 Oct.	
Weeks post-ORV	23-50	4-5	0-10	8	
ORV bait type @ bait density	CS @ 70 baits/km^2	CS @ 35 baits/km^2	CS @ 70 baits/km^2	CS @ 140 baits/km^2	
Unique raccoons	1,043	34	441	5	1,523
			Serology		
Testable blood samples	761[a]	33	190[b]	5	989
Positive rabies antibody response (≥0.05 IU)	226 (29.7%)	1 (3.0%)	51 (26.8%)	1 (20.0%)	279 (28.2%)

[a] Includes 5 previously vaccinated raccoons, of which 3 had detectable rabies antibodies when recaptured in 2007: 1 was vaccinated by WS 2 weeks prior in 2007; 1 by Quebec in 2006; and 1 by WS in 2000. One of the vaccinated raccoons that did not sero-convert was vaccinated in 2000 and the other was only vaccinated 1 day prior to recapture in 2007.

[b] Includes 13 raccoons with a record of hand vaccination 7-13 weeks prior; all had detectable rabies antibodies when recaptured in 2007. One of those 13 had serum collected the first time it was trapped in 2007 and it had antibodies then too.

Serum samples were also collected from 6 raccoons that were not trapped, but collected during enhanced surveillance activities (as road kills). Two of them demonstrated a positive antibody response (7 and 42 weeks post-ORV bait distribution, respectively), and both of their brainstems tested positive for the rabies virus as well.

In addition to raccoons, sera were collected from 91 skunks, 4 fishers, and 1 red fox. Samples were collected prior to 2007 ORV distribution (but 37-49 weeks after 2006 baiting) and 0-10 weeks after 2007 ORV. Two skunks demonstrated a positive rabies antibody response, 38 and 49 weeks following 2006 ORV baiting. Since 2003, WS has collected sera from 178 skunks in Vermont; these were the first to have rabies antibodies. The fishers and red fox from 2007 did not have detectable antibodies.

Biomarker and Age.--In 2007, teeth were collected from 1,312 animals: 1,193 raccoons, 107 skunks, 5 red foxes, 3 coyotes, 3 fishers, and 1 woodchuck. These teeth were collected during enhanced surveillance, coordinated TVR, density studies, and post-bait trapping activities. Only 611 of these samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA) to be analyzed for age and biomarker. The age results were pending at the time of this report, but the samples had been tested for biomarker. Six samples were not able to be tested because they were too badly broken. Of the 605 teeth that were analyzed, 36 (6.0%) showed the presence of tetracycline biomarker. Coated sachet baits (which do not contain a biomarker) have been aerially distributed in Vermont since 2001, while FMP baits are still hand distributed in areas too populated to bait by air. Nine of the 36 biomarker positive samples were collected from a hand-baited area.

SUMMARY

The summer of 2007 marked the eleventh year of WS cooperative participation in the Vermont ORV Program. Over 420,000 baits were distributed across Vermont's 3 ORV zones with varying densities: low (35 baits/km2), standard (70 baits/km2), and high (140 baits/km2). Enhanced surveillance led to the collection of 705 animals by WS (up from 139 in 2006). The VDH confirmed 165 rabid animals; 162 with raccoon variant, the highest number of raccoon rabies cases ever confirmed in Vermont. By years end, WS trapped, vaccinated, and released 1,226 animals including 1,151 raccoons. Ten raccoon density studies were conducted: 2 in the low bait density zone and 8 in the standard bait zone. Trapping post-2007 ORV yielded serum samples from 228 raccoons in all 3 bait zones; 23.2% had detectable rabies antibodies.

In 2008, WS will continue coordinated TVR efforts, but shift focus to the Lake Memphremagog basin in Orleans County to prevent rabies entering Quebec from that area. Wildlife Services will continue to enhance rabies surveillance and distribute ORV baits, with plans to eliminate the low bait density zones, increase the standard zone to 75 baits/km^2 and the high density zone to 150 baits/km^2. The 8 density studies in Franklin County (4 prior to annual ORV and 4 post-ORV) will be repeated and trapping post-ORV to monitor program effectiveness will continue. Wildlife Services will maintain communications and work closely with Quebec officials to coordinate field work and maximize efforts to contain (and explore strategies to eliminate) the raccoon variant of rabies from Vermont and Quebec.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
VIRGINIA 2007

BACKGROUND

In 1977, raccoon (*Procyon lotor*) rabies was first introduced to the mid-Atlantic region of the United States with the translocation of infected raccoons from Florida to Hardy County, West Virginia and Shenandoah County, Virginia. From these counties, the disease spread rapidly along the east coast and has now become enzootic in all of the East Coast states, as well as Alabama, Pennsylvania, Vermont, West Virginia, and eastern Ohio. Wildlife Services (WS) has been involved in an oral rabies vaccination (ORV) program to control raccoon rabies in Virginia since 2002. The ORV program in Virginia is part of the Appalachian Ridge (AR) ORV project and of a larger, cooperative effort to stop the westward spread of the raccoon variant of rabies in the eastern United States.

The raccoon variant of rabies occurs throughout Virginia, with the exception of 3 counties (Dickenson, Lee, and Wise) on the southwestern border with Kentucky (Figure 1). According to the Virginia Department of Health (VDH), Office of Epidemiology, infected raccoons accounted for 359 (49.2%) of the 730 animal rabies cases reported in Virginia during 2007. During the past 10 years, January 1998-December 2007, raccoons have accounted for 3,118 (54.9%) of the 5,675 laboratory confirmed cases of animal rabies statewide. Wildlife Services is working in cooperation with the VDH, the Virginia Department of Game and Inland Fisheries (VDGIF), and local animal control officers to provide as many rabies surveillance specimens as possible.

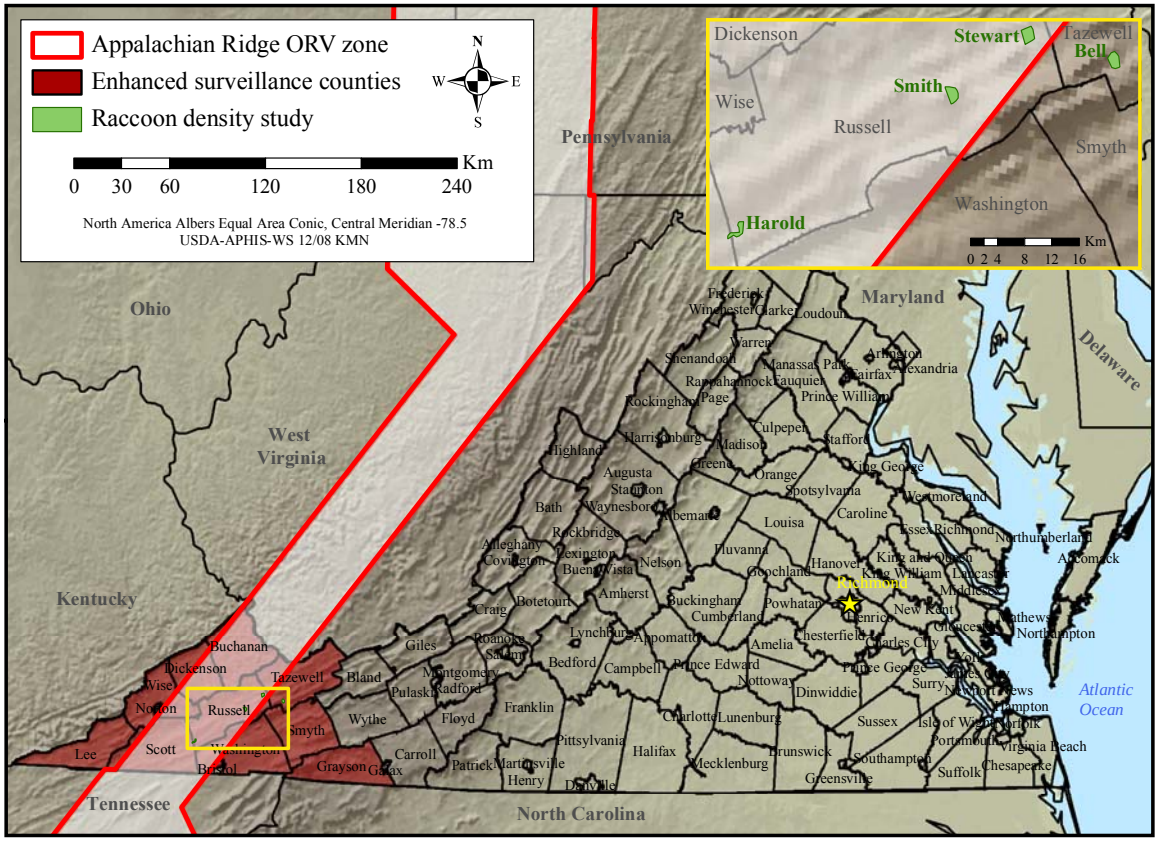

Figure 1. Wildlife Services cooperative rabies management program activities in Virginia, 2007.

ORV PROGRAM 2007

Bait Distribution

For the sixth consecutive year, WS participated in bait distribution efforts in southwestern Virginia as part of the larger AR ORV zone; 320,365 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia,

USA) were distributed over 5,053 km^2 (1,951 mi^2) in 2007 (Figure 1). Since its program inception in 2002, WS has cooperated to distribute 2,106,806 ORV baits in Virginia.

Aerial baiting was based out of Greenville, Tennessee from 8-10 October, with 309,205 fishmeal-coated sachet (CS) baits distributed over 7 counties in southwestern Virginia. Fixed-wing aircraft were provided by Dynamic Aviation Group Inc. (Bridgewater, Virginia, USA), while WS personnel served as navigators and flight crew in the rear of the plane. Planes flew at approximately 150-300 meters altitude and flight lines were spaced approximately 500 meters apart. Baits are distributed via ground operations (hand and vehicle) in areas too populated to bait by air. From 12-16 October, WS distributed 11,160 fishmeal polymer (FMP) ORV baits in several urban and suburban areas of southwest Virginia: Castlewood, Cedar Bluff, Claypool Hill, Coeburn, Gate City, Grundy, Lebanon, Raven, Richlands, St. Paul, and Weber City.

Enhanced Surveillance

During 2007, WS cooperated with the VDH, the Virginia Department of Transportation, the VDGIF, county animal control officers, and local trappers to collect 162 animals from counties in or adjacent to the ORV zone to enhance rabies surveillance in southwestern Virginia. These samples were from road killed, strange-acting, injured, or nuisance animals and from carcasses collected from fur trappers that otherwise would not have been tested through the public health surveillance system.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the direct fluorescent antibody (dFA) test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

In 2007, WS tested 162 (100%) of the enhanced surveillance samples using the dRIT. One raccoon tested positive for raccoon variant rabies and 1 striped skunk (*Mephitis mephitis*) tested positive for north central skunk variant (Table 1).

Table 1. Animals tested for rabies by Wildlife Services using the direct rapid immunohistochemistry test (dRIT) from counties within or adjacent to the oral rabies vaccination (ORV) zone in Virginia, 2007 (rabies positives in parentheses).

County	Raccoon	Striped Skunk	Gray fox	Bobcat	Coyote	Red fox	Total
Buchanan	5			1			6
Dickenson	1						1
Grayson		1					1
Lee	6	3 (1)	1		1	2	13 (1)
Russell	42						42
Scott	17						17
Smyth	18	1	1	2			22
Tazewell	24 (1[a])		2			1	27 (1)
Washington	17	2	2	2	3	1	27
Wise	4				1	1	6
Total	134 (1)	7 (1)	6	5	5	5	162 (2)

[a] Collected east of the ORV zone.

All positives and 10% of all negative samples were sent to the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia for confirmation and strain typing. The CDC (using the dFA test) had 100% agreement with the WS dRIT results for positive and negative samples. Antigenic typing conducted by the CDC determined that the rabies virus in the positive raccoon from Smyth County was consistent with the raccoon variant found in the eastern U.S. and the skunk from Lee County was consistent with the north central skunk variant. Wildlife Services will continue to use the dRIT in 2008 to enhance surveillance of suspect rabid animals in Virginia.

Population Monitoring

In 2007, WS conducted 4 raccoon density studies (3 in Russell County, 1 in Tazewell County) using the National Rabies Management Program standard protocol of 50 cage traps set on a target study area of 3 km^2 (1.2 mi^2) for 10 consecutive nights (Figure 1 inset). All studies were conducted in agricultural areas representative of habitat found throughout the Virginia ORV zone. Over 2,000 trap nights, 158 unique raccoons were captured and blood and tooth samples were collected from all of them (Table 2). During the studies, 150 raccoons were immobilized, processed and released, while 8 raccoons were euthanized at the landowner's request or because of injuries/lesions. Brainstem samples were collected from the 8 raccoons and tested for rabies by WS using the dRIT (Table 1). All samples tested negative for the presence of rabies. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Table 2. Index to raccoon densities in Tazewell and Russell Counties, Virginia, 2007.

	Tazewell (Bell)	Russell (Smith)	Russell (Stewart)	Russell (Harold)
Time of study	9-19 July	23 July-2 August	6-16 August	20-30 August
Macrohabitat	Agriculture	Agriculture	Agriculture	Agriculture
Target trap nights	500	500	500	500
Unique raccoons	44	20	51	43
Recaptured raccoons	11	3	12	8
Non-target captures[a]	35	9	20	15
Area (km^2)	3.00	3.19	3.36	2.10
Raccoon density index[b]	14.7	6.3	15.2	20.5

[a] Includes non-target captures and traps that were otherwise unavailable to capture a raccoon (sprung, stolen, etc.).
[b] Unique raccoons/km^2.

Post-ORV Monitoring

During November and December 2007, WS conducted trapping activities 4-7 weeks post-aerial ORV bait distribution in Russell, Scott, and Washington Counties. Over 2,128 trap nights, 212 unique raccoons were captured on public and private lands (210 and 182 serum and tooth samples were collected, respectively). Three raccoons were found dead at trap sites, 17 raccoons were euthanized due to injury or at the request of landowners, 1 raccoon died under anesthesia and 191 raccoons were immobilized, processed and released.

Non-target Captures

Non-target animals captured and released by WS in 2007 included: 38 opossums (*Didelphis virginiana*), 3 Eastern cottontails (*Sylvilagus floridanus*), 1 Eastern box turtle (*Terrapene carolina*), and 1 woodchuck (*Marmota monax*).

Non-target animals that were captured and euthanized by WS (at the request of landowners) in 2007 included: 51 opossums and 10 woodchucks.

Laboratory Cooperation

The ORV program in Virginia cooperates with the Virginia Division of Consolidated Laboratory Services (VDCLS) and the CDC.

Virginia Division of Consolidated Laboratory Services.--The VDCLS tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure). They also work with WS to test a limited number of enhanced surveillance samples (specimens not involved in an exposure) from areas within and adjacent to the ORV zone. In 2007, the VDCLS tested 4,543 samples for the rabies virus and confirmed 730 cases of rabies (Table 3).

Raccoons, skunks, and foxes (*Canidae* spp.) are of priority interest to WS and cooperators involved in ORV. These carnivores are common rabies vectors throughout the U.S. and the animals most frequently collected

and tested by WS to enhance rabies surveillance. Many additional species, when involved in human or domestic animal exposures to the rabies virus, are of priority interest to public health agencies. This explains why 73.4% of the animals tested for rabies by the VDCLS in 2007 are reported by WS as "other." For a full listing of rabid animals from Virginia in 2007 please visit the VDH's rabies website: http://www.vdh.virginia.gov/Epidemiology/DEE/Rabies/

Table 3. Animals tested for rabies by the Virginia Department of General Services – Division of Consolidated Laboratory Services in Virginia, 2007 (percent rabies positive in parentheses).

	Statewide		Within and adjacent to Virginia ORV zone[a]	
	Number tested	Number rabid	Number tested	Number rabid
Raccoons	757	359 (47.4%)	66	10 (15.1%)
Skunks	261	185 (70.8%)	11	6 (54.4%)
Foxes	189	90 (47.6%)	5	1 (20.0%)
Other[b]	3,336	96 (2.9%)	151	3 (2.0%)
Total	4,543	730 (16.1%)	233	20 (8.5%)

[a] Samples from Buchanan, Dickenson, Lee, Russell, Scott, Smyth, Tazewell, Washington, and Wise Counties and the cities of Bristol and Norton.
[b] Other animals included: bats, bobcats, cats (domestic/feral), cows, dogs (domestic/feral), goats, horses, and woodchucks (groundhogs).

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). Virginia WS submitted 368 blood serum samples for rabies VNA analysis to the CDC in 2007. This represents a 64.6% increase from the 238 samples submitted by WS in 2006. The Virginia ORV program anticipates similar numbers of serum sample submissions to the CDC in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology, and prevention and control) on a national level please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, WS live-trapped 370 unique raccoons: 44 in an ORV naïve density study area; 114 were 49-55 weeks post-2006 ORV (during density studies); and 212 were 5-9 weeks post-2007 ORV bait distribution (Table 4). Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Biomarker results were available, but age results were pending from Matson's at the time of this report.

During density studies that were conducted 49-55 weeks after 2006 ORV but before 2007 ORV, 25.4% of raccoons demonstrated a positive rabies antibody response (down from 54.9% of raccoons in studies 44-47 weeks after 2005 ORV but before 2006 ORV). During AR ORV evaluation (5-9 weeks after 2007 ORV), 39.0% of raccoons had rabies antibodies (down from 57.2% of raccoons 4-7 weeks after 2006 ORV). During the ORV naïve density study in Tazewell County, 61.4% of raccoons had detectable rabies VNA. This study was approximately 8.3 km (5 mi) from the nearest ORV zone. There had been no indication of translocation events into the study area. Wildlife Services plans to re-evaluate these sera samples in an effort to better explain why serology may have been so high in an area never before treated with ORV. In addition to raccoons, a blood sample was collected from 1 red fox during the Tazewell County density study (ORV naïve); it did not have rabies antibodies.

In 2007, 324 teeth were tested for the presence of tetracycline biomarker. For density trapping, tetracycline biomarkers were detected in both ORV naïve and ORV baited areas. In ORV baited density studies, 16.3% of samples had tetracycline biomarker present. In the ORV naïve samples, 2.5% of samples recorded exposure to tetracycline on two or more separate occasions. For post ORV evaluation, 10.5% of samples showed biomarker. The relatively low rates of biomarker presence are expected because CS baits were aerially distributed in 2006 and 2007.

Table 4. Serology and tetracycline biomarker results of raccoon biological samples collected by Wildlife Services during cooperative rabies management program activities in Virginia, 2007.

	Density study ORV naïve	**Density studies post-2006 ORV**	**AR[a] evaluation post-2007 ORV**
Sample collection timeframe	9-19 Jul.	23 Jul.-30 Aug.	12 Nov.-14 Dec.
Weeks post-ORV	n/a[b]	49-55	5-9
ORV bait type/ distribution method	n/a	CS/fixed-wing & FMP/hand	CS/fixed-wing & FMP/hand
Unique raccoons	44	114	212
		Serology	
Testable blood samples	44	114	210
Positive rabies antibody response (≥0.05 IU)	27 (61.4%)	29 (25.4%)	82 (39.0%)
		Tetracycline biomarker[c]	
Testable tooth samples	39	104	181
Presence of tetracycline biomarker	1 (2.6%)	17 (16.3%)	19 (10.5%)

[a] AR=Appalachian Ridge; ORV=oral rabies vaccination; CS=coated sachet; FMP=fishmeal polymer.
[b] Samples were collected in an ORV naïve area (never before treated with ORV).
[c] Coated sachet baits (no biomarker) were aerially distributed in 2006 and 2007.

SUMMARY

During 2007, WS completed its sixth year of cooperative participation in rabies management in Virginia, and its fifth year conducting ORV bait distribution activities. Other activities in 2007 included: ORV bait distribution; enhancing surveillance of raccoon rabies by collecting and testing road killed, strange-acting and nuisance animals from counties within and adjacent to the ORV zone; conducting raccoon density studies; and trapping post-ORV bait distribution to monitor and evaluate raccoon serology and biomarker uptake in southwestern Virginia. By year's end, WS had distributed over 320,000 ORV baits, collected and tested (using the dRIT) 162 enhanced surveillance animals, conducted 4 raccoon density studies, and collected serum samples from 210 raccoons during post-2007 ORV trapping, yielding 39.0% with detectable rabies antibodies.

In 2008, WS will continue to distribute baits, conduct density studies, enhance rabies surveillance, and conduct post-ORV trapping to monitor program efficacy. Future ORV baiting strategies in Virginia will continue to be tied to national and international planning efforts to contain, and explore strategies to eliminate, the raccoon variant of rabies in North America.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
WEST VIRGINIA 2007

BACKGROUND

Raccoon (*Procyon lotor*) rabies was first introduced into West Virginia in 1977, from raccoons translocated from the southern United States to Hardy County (Figure 1). The virus then spread along the leeward side of the Appalachian Mountains into Pennsylvania, Maryland, and Virginia until it breached the Appalachian Mountain front and began spreading in the cardinal directions through West Virginia. Wildlife Services (WS) became involved in an oral rabies vaccination (ORV) program to control raccoon rabies in West Virginia in 2001. The ORV program in West Virginia is part of the Appalachian Ridge (AR) ORV project and of a larger, cooperative effort to stop the westward spread of the raccoon variant of rabies in the eastern United States.

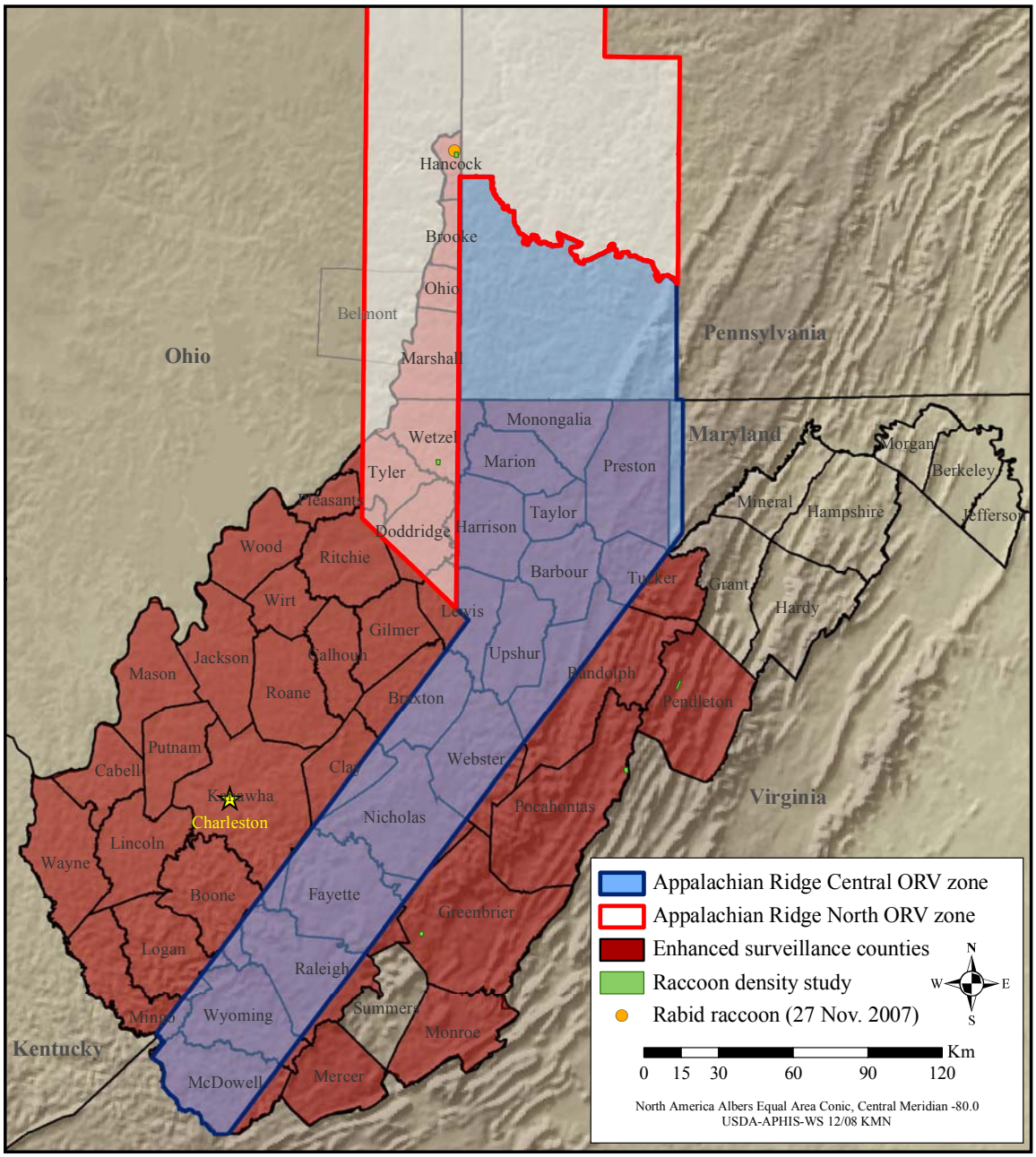

Figure 1. Wildlife Services cooperative rabies management program activities in West Virginia, 2007.

The West Virginia ORV program is coordinated by the West Virginia Department of Agriculture (WVDOA), while surveillance is being conducted by the West Virginia Department of Health and Human Resources (WVDHHR), WS, and County Departments of Health. Wildlife Services provides funding and operational support, including coordination of ORV bait distribution activities, raccoon population monitoring, and program evaluation through live trapping efforts. The West Virginia Division of Natural Resources (WVDNR) provides permits for handling wildlife, access to state owned property, and expertise in raccoon ecology and management.

ORV PROGRAM 2007

Bait Distribution

For the seventh consecutive year, WS participated in bait distribution efforts along the AR in West Virginia via 2 distinct baiting efforts (a central and north campaign); 1,388,231 baits containing Raboral V-RG® vaccine (Merial Limited, Athens, Georgia, USA) were distributed over 25,029 km^2 (9,777 mi^2) in 2007 (Figure 1). Since its program inception in 2001, WS has cooperated to distribute 10,085,933 ORV baits in West Virginia. Fixed-wing aircraft and pilots for both operations were provided by the Ontario Ministry of Natural Resources, while WS personnel served as navigators and flight crew in the planes. Ground support for aerial baiting was provided by: the WVDHHR, the WVDOA, the WVDNR, the Ohio National Guard, the Ohio Department of Health, and WS employees from West Virginia, Virginia, Tennessee, Kentucky, Ohio, and Pennsylvania.

Appalachian Ridge Central.--In 2007, the southern portion of the West Virginia AR ORV zone was renamed AR Central and covered 18,638 km^2 (7,197 mi^2) in 29 counties (Figure 1). Aerial baiting was based out of Buckhannon, West Virginia from 23-28 August, with 1,092,986 CS baits distributed via fixed-wing aircraft. (This includes 187 CS baits that were distributed in Hancock County during aerial baiting based out of Port Meadville, Pennsylvania from 12-14 August.) Ground baiting was conducted from 5-14 September; 27,494 FMP baits were distributed via hand baiting in parts of 18 counties.

Appalachian Ridge North.--In 2007, the northern portion of the West Virginia AR ORV zone covered 6,392 km^2 (2,468 mi^2) in 15 counties (Figure 1). Aerial baiting was based out of North Lima, Ohio from 31 August-5 September, with 267,564 CS baits distributed via fixed-wing aircraft.

Enhanced Surveillance

In 2007, WS enhanced surveillance of raccoon rabies by collecting and testing 1,346 animals from 47 counties in or adjacent to the West Virginia ORV zone (Table 1). Wildlife Services collected 802 animals during road kill surveillance and 544 animals from various nuisance wildlife control officers and fur trappers. All samples were tested by WS using the direct rapid immunohistochemistry test (dRIT) and 8 of 1,346 animals (0.6%) tested positive for rabies; they were all raccoon variant.

Table 1. Animals tested for rabies by Wildlife Services using the direct rapid immunohistochemistry test (dRIT) from counties within or adjacent to the oral rabies vaccination (ORV) zone in West Virginia, 2007 (rabies positives in parentheses).

County	Raccoon	Skunk	Coyote	Gray fox	Red fox	Bobcat	Opossum	Total
Barbour	15	1						16
Boone	5	1						6
Braxton	20	8		1		1		30
Brooke	39							39
Cabell[a]	14	4		1	1			20
Calhoun[a]	2	1	1			1		5
Clay	4							4
Doddridge	1							1
Fayette	50	3 (1)	5	1				59 (1)
Gilmer[a]	9	1						10
Greenbrier[a]	3 (1)		2	2	1			8 (1)
Hancock	71 (2)							71 (2)
Harrison	40	4		2				46
Jackson[a]	68	7						75
Kanawha	78			2				80
Lewis	16					1		17
Lincoln[a]	22	8		4				34
Logan	4		1					5
Marion	33	1			1			35
Marshall	197 (1)	1			1			199 (1)
Mason	11	1		1				13
McDowell	11		1	1				13
Mercer	5							5
Mingo	2	2	1					5
Monongalia	59	1			1			61
Monroe	1 (1)							1 (1)
Nicholas	13	9	10	2			1	35
Ohio	161 (1)							161 (1)
Pendleton[a]	2	1		1				4
Pleasants[a]	5							5
Pocahontas	7							7
Preston	15							15
Putnam	5	2						7
Raleigh	44 (1)			3				47 (1)
Randolph	3							3
Ritchie	9		1		1			11
Roane[a]	13		1			2		16
Taylor	18							18
Tucker	4						1	5
Tyler	10							10
Upshur	4	1	1					6
Wayne[a]	16	1		1	1			19
Webster			1					1
Wetzel	44				5			49
Wirt[a]	6					1		7
Wood[a]	26	6			2			34
Wyoming	17	1	2	5		3		28
Total	1,202 (7)	65 (1)	27	27	14	9	2	1,346 (8)

[a] ORV not applied in this county.

Population Monitoring

In 2007, WS conducted 5 raccoon density studies (1 each in Hancock, Greenbrier, Pocahontas, Wetzel, and Pendleton Counties) using the National Rabies Management Program (NRMP) standard protocol of 50 cage traps set on a target study area of 3 km^2 (1.2 mi^2) for 10 consecutive nights (Figure 1). The Hancock and Wetzel studies were each conducted on wildlife management areas, managed by the WVDNR, and were representative of habitat found throughout much of the state with forested rolling hills and permanent streams. The Greenbrier study site was composed of pasture and forest lands. The Pendleton study site was composed of forest lands, pasture, and a small community of approximately 280 residents. The Pocahontas study site was composed of forest lands above 3,500 ft in elevation. The Hancock and Wetzel studies were conducted in the ORV zone, while the Pocahontas, Greenbrier, and Pendleton studies were conducted outside of the bait zone in ORV naïve areas (never previously treated with ORV). Raccoon density estimates are critical for use in future plans to potentially shift the ORV zone to the east. During the 5 studies, 171 unique raccoons were captured and density indices ranged from 5.3-22.7 raccoons/km^2 (Table 2). All raccoons were immobilized, processed and released. All animals captured by WS in 2007 were trapped in accordance with federal, state, and local laws and handled according to the American Society of Mammalogists, Animal Care and Use Committee guidelines.

Table 2. Index to raccoon densities in Hancock, Wetzel, Greenbrier, Pocahontas, and Pendleton Counties, West Virginia, 2007.

	Hancock	Wetzel	Greenbrier[a]	Pocahontas[a]	Pendleton[a]
Time of study	10-20 July	10-20 July	10-20 July	23 Jul.-2 Aug.	24 Jul.-3 Aug.
Macrohabitat	Agriculture	Forested	Agriculture	Forested	Forested
Target trap nights	500	500	500	500	500
Unique raccoons	64	34	35	16	22
Recaptured raccoons	16	12	16	7	5
Non-target captures	26	10	14	3	19
Area (km^2)	2.82	2.92	2.94	3.04	3.29
Raccoon density index[b]	22.7	11.6	11.9	5.3	6.7

[a] ORV not applied in this county.
[b] Unique raccoons/km^2.

Post-ORV Monitoring

From September-October 2007, WS conducted trapping activities 3-6 weeks post-ORV bait distribution in Nicholas, Ohio, Raleigh, Taylor, Wetzel, and Wyoming Counties. As a result, biological samples were collected from 133 raccoons and 4 striped skunks (*Mephitis mephitis*). Of these, 56 raccoons and 2 skunks were euthanized at the request of landowners, while the remaining animals were released. All 58 animals were tested by WS using the dRIT and were negative for rabies. All animals euthanized by WS in 2007 were done so in accordance with the American Veterinary Medical Association's Panel on Euthanasia recommendations.

Coordinated TVR

From 2002-2006, the northern panhandle of Brooke, Hancock, Marshall, and Ohio Counties collectively averaged about 5 rabid animals (with raccoon variant) annually. These cases have consistently posed a threat to the AR North ORV zone in West Virginia and Ohio. In November 2005, Ohio confirmed a rabid skunk in Belmont County, the first ever animal confirmed with raccoon rabies west of the Ohio River (state border with West Virginia) which had presumably served as a natural barrier to the spread of raccoon rabies. The persistent cases in the West Virginia panhandle counties may have led to the rabid skunk in Ohio. As a result, West Virginia developed a contingency plan in the event that another case was detected in the panhandle.

On 15 November 2007, WS collected a road kill raccoon in Hancock County and confirmed it as rabid (using the dRIT) on 27 November (Figure 1). Wildlife Services followed its contingency plan by increasing surveillance in a 26 km^2 (10 mi^2) area around the case. Through the remainder of November and December, 45 more raccoons were collected and tested. One more tested rabid (Table 1). From 11-14 December, a trap-vaccinate-release (TVR) effort was conducted in a 5 km^2 (2 mi^2) area around the initial case. Fifteen raccoons were trapped and hand vaccinated with 1 ml of Imrab3® rabies vaccine (Merial Limited) and released before an ice storm moved in that halted the effort.

Other Rabies Management Program Activities

Habitat Characteristics Study.--For the sixth consecutive year, WS collected habitat data to determine the relationship of habitat composition and elevation to raccoon relative abundance (Table 3). Habitat characteristics are important variables that need further research because the historical spread of rabies through West Virginia appeared to be slowed by the higher elevations of the Appalachian Mountains. Several habitat characteristics were measured at 200 locations during raccoon trapping activities. At each trap location a 7.97 m (26.3 ft) diameter plot was sampled, with the trap centered in each plot. Wildlife Services will continue to collect these data in 2008.

Table 3. Mean habitat characteristics measured at trap locations that captured and did not capture raccoons in West Virginia, 2007.

Habitat Characteristics	Capture site	Non-capture site
Basal area[a] (ft^2)	4.7	3.85
Trees >11" dbh[b]	2.0	2.46
Trees <11" dbh	7.4	10.27
Ground vegetation cover (%)	83.1	76.76
Canopy cover (%)	62.1	62.51
Distance (m) to water-intermittent <100m	5.55	4.43
Distance (m) to water-permanent <100m	17.78	20.31
Slope (%)	9.4	9.33
Elevation (ft)	1,932	2,861
Den sites per plot	0.12	0.21
Number of tree/shrub species per plot	1.31	0.61
Red Oak (*Quercus rubra*)	0.42	0.45
White Oak (*Quercus alba*)	0.39	0.51
Beech (*Fagus grandifolia*)	0.19	0.61
Hickory (*Carya spp.*)	0.30	0.34
Other Hard Mast	0.18	0.09
Common apple (*Malus sylvestris*)	0.19	0.02
Black cherry (*Prunus serotina*)	1.1	0.53
Flowering dogwood *(Cornus florida*)	0.13	0.02
Blackberry (*Rubus spp.*)	5.7	2.14
Autumn Olive (*Elaeagnus umbellate*)	0.01	0.02
Other Soft Mast	5.8	2.01

[a] Calculated using a 20-factor prism.
[b] dbh=diameter at breast height.

Non-target Captures

Non-target (not processed, sampled, or vaccinated) animals captured and released by WS in 2007 included: 50 opossums (*Didelphis virginiana*), 6 Eastern cottontails (*Sylvilagus floridanus*), 3 domestic cats (*Felis catus)*, 3 unidentified turtles (*Testudines* spp.), 2 woodchucks (*Marmota monax*), 1 domestic dog (*Canis lupus familiaris*), 1 fox squirrel (*Sciurus niger*), and 1 varied thrush (*Ixoreus naevius*).

Non-target animals that were captured and euthanized by WS in 2007 included: 20 woodchucks, 7 opossums, and 1 unidentified poisonous snake (*Viperidae* spp.). These animals were euthanized at the request of landowners.

Rabies Laboratory Cooperation

The ORV program in West Virginia cooperates with the WVDHHR and the CDC.

West Virginia Department of Health and Human Services.--The WVDHHR tests animal brainstems for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure usually submitted by conservation officers, veterinarians, and the public) and enhanced surveillance (specimens not involved in an exposure and usually submitted by WS). In 2007, the WVDHHR tested 1,106 samples for the rabies

virus and confirmed 77 cases of rabies in West Virginia. Including the 8 rabid animals from dRIT, 85 cases of rabies were confirmed in West Virginia in 2007: 61 raccoons, 13 striped skunks, 4 bats (*Chiroptera* spp.), 4 cats, 2 foxes (*Canidae* spp.), and 1 woodchuck.

Of the 1,106 samples tested by the WVDHHR, 490 were tested because of human exposures, 161 were tested because of domestic animal exposures, and 455 were tested for other reasons. The 2007 samples were submitted from all 55 counties throughout the state. For a full listing of rabid animals from West Virginia by species and location from 2002-2007 please visit the WVDHHR's rabies website: http://www.wvdhhr.org/idep/a-z/a-z-rabies.asp

Centers for Disease Control and Prevention.--The CDC analyzes wildlife blood serum samples (submitted by WS) for levels of rabies virus neutralizing antibodies (VNA). West Virginia WS submitted 306 blood serum samples for rabies VNA analysis to the CDC in 2007. This represents a 20% decrease from the 382 samples submitted by WS in 2006. The West Virginia ORV program anticipates an increase in numbers of serum sample submissions to the CDC in 2008. For more information about the rabies virus (its natural history, diagnosis, epidemiology on a national scale, and prevention and control) please visit the CDC's rabies homepage: http://www.cdc.gov/rabies/

ORV PROGRAM 2007 – EVALUATION

Typically, WS presents ORV program evaluation data (serology, tetracycline, and age results) from the previous year's monitoring to provide time for laboratory analyses. At the time of this report however, some of the current year's (2007) evaluation data were available so they have been included here instead (2006 results were included in the 2006 annual report).

Serology, Tetracycline Biomarker, and Age Results

Raccoon blood sera are analyzed to detect rabies VNA (or rabies vaccination levels) and the tooth is analyzed to determine animal age and bait uptake (when appropriate: FMP baits contain a chemical biomarker, tetracycline, which stains teeth/bone and can be detected under microscope; CS baits do not contain this biomarker). Presence of tetracycline in a tooth may indicate that the animal consumed part of the FMP bait matrix (outer portion of the bait). However, presence of tetracycline does not confirm that the vaccine sachet was punctured or consumed, thus the need for sera evaluation as well.

In 2007, WS live-trapped 319 unique raccoons: 73 in ORV naïve density study areas; 98 were 44-45 weeks post-2006 ORV (during density studies); 133 were 3-6 weeks post-2007 ORV bait distribution; and 15 were during a small-scale TVR effort 15 weeks post-2007 ORV (Table 4). Blood and tooth samples were collected from most of these animals and serum samples were sent to the CDC, while tooth samples were sent to Matson's Laboratory LLC (Milltown, Montana, USA). Biomarker and age results were pending from Matson's at the time of this report.

During density studies that were conducted 44-45 weeks after 2006 ORV but before 2007 ORV, 49.5% of raccoons demonstrated a positive rabies antibody response. This was similar to samples from 2006 that were collected 48-49 weeks post-2005 ORV (48.0% antibody response). During AR ORV evaluation (3-6 weeks after 2007 ORV), 48.9% of raccoons had rabies antibodies (up from 35.8% of raccoons 4-11 weeks after 2006 ORV). During a small TVR effort (15 weeks after 2007 ORV), 13.3% of raccoons had rabies antibodies. During the ORV naïve density studies in Greenbrier, Pendleton, and Pocahontas Counties, 64.4% of raccoons had detectable rabies VNA. These studies were approximately 13-40 km (7.8-24 mi) from the nearest ORV zone. There had been no indication of translocation events into the study areas. Wildlife Services plans to re-evaluate these sera samples in an effort to better explain why serology may have been so high in an area never before treated with ORV. In addition to raccoons, blood samples were collected from 4 skunks (2 during post-2007 ORV trapping and 2 during ORV naïve density studies). None of the skunks had rabies antibodies.

Table 4. Serology results of raccoon biological samples collected by Wildlife Services during cooperative rabies management program activities in West Virginia, 2007.

	Density studies ORV naïve[a]	Density studies post-2006 ORV[b]	AR[c] evaluation post-2007 ORV	Coordinated TVR post-2007 ORV
Sample collection timeframe	10 Jul.-3 Aug.	10-20 July	17 Sep.-12 Oct.	11-14 Dec.
Weeks post-ORV	n/a[b]	44-45	3-6	15
ORV bait type/ distribution method	n/a	CS/fixed-wing & FMP/hand	CS/fixed-wing & FMP/hand	CS/fixed-wing & FMP/hand
Unique raccoons	73	98	133	15
	Serology			
Testable blood samples	73	97	133	15
Positive rabies antibody response (≥0.05 IU)	47 (64.4%)	48 (49.5%)	65 (48.9%)	2 (13.3%)

[a] Density studies conducted in Greenbrier, Pendleton, and Pocahontas Counties were ORV naïve (never before treated with ORV).
[b] Density studies conducted in Wetzel and Hancock Counties were last treated with ORV in September 2006.
[c] AR=Appalachian Ridge; ORV=oral rabies vaccination; CS=coated sachet; FMP=fishmeal polymer.

SUMMARY

During 2007, WS completed its seventh year of cooperative participation in rabies management in West Virginia including ORV bait distribution activities. Other activities in 2007 included: enhancing surveillance of raccoon rabies by collecting and testing road killed, strange acting and nuisance animals from counties within and adjacent to the ORV zone; conducting raccoon population density studies within the AR ORV zone and in ORV naïve areas east of the zone; and trapping post-ORV bait distribution to monitor and evaluate raccoon serology and biomarker uptake throughout West Virginia's portion of the AR ORV zone.

In 2008, WS will continue to: conduct enhanced rabies surveillance within and adjacent to the current AR ORV zone; investigate the influence of elevation and habitat by collecting pertinent habitat data at each trap location; and monitor and evaluate ORV program efficacy by collecting raccoon serology. Wildlife Services will participate in a cooperative study to identify uptake of placebo baits by meso-carnivores using trail cameras and trapping efforts to identify species and tetracycline deposition within observed animals. West Virginia WS will evaluate pulse baiting strategies and conduct sampling in the pulse bait study area in Ohio. This area will encompass portions of Monroe and Washington Counties in Ohio and will require pretreatment sampling of at least 50 samples, participation in helicopter baiting of this 400 mi^2 (1,036 km^2) area and post-bait monitoring of at least 120 animals from within the inner 100 mi^2 (259 km^2) area. In addition, WS personnel will begin working on the continuation of a study previously conducted by Ohio WS to further identify the use of bridges, locks and dams that span the Ohio River by potentially rabid raccoons.

WILDLIFE SERVICES COOPERATIVE RABIES MANAGEMENT PROGRAM
WYOMING 2007

BACKGROUND

The striped skunk (*Mephitis mephitis*) is the primary reservoir of terrestrial rabies in Wyoming. The North Central skunk variant of the rabies virus is enzootic in the northeastern counties of Wyoming and typically occurs throughout the Missouri River drainage system (Figure 1). A bat variant of the rabies virus, common in big brown bats (*Eptesicus fuscus*), occurs throughout the state.

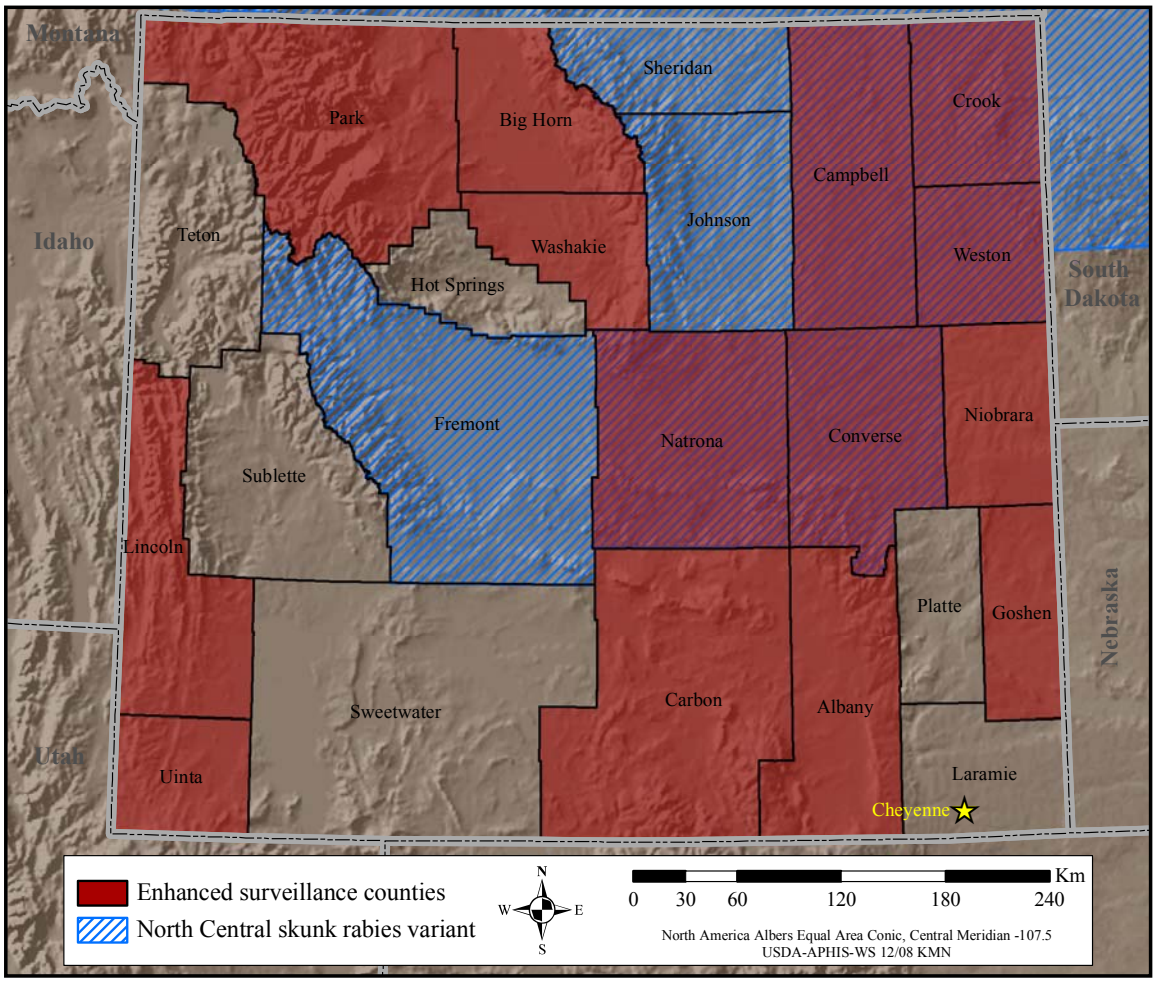

Figure 1. Wildlife Services cooperative rabies management program activities in Wyoming, 2007.

In 2002, the Wyoming Legislature directed the Wyoming Animal Damage Management Board (ADMB) to develop and implement a wildlife rabies management program. The Board, as directed by statute, was charged with promulgating rules pertaining to rabies prevention in wildlife including: surveillance; public education and prevention; vaccination protocol; post-exposure procedures and quarantines; and entering into agreements with law enforcement agencies to carry out quarantine provisions. To comply with this directive, the ADMB signed a memorandum of understanding with Wildlife Services (WS) to provide specimens (primarily skunks) from across the state to the Wyoming State Veterinary Laboratory (WSVL) in Laramie for rabies testing.

In 2003 and 2004, Wyoming WS assisted in a multi-state, long-term study coordinated by WS' National Wildlife Research Center to evaluate bait acceptance of oral rabies vaccine (ORV) placebo baits by skunks. The ultimate goal is to pair an attenuated virus vaccine with a bait matrix highly preferred by skunks for use in a broad-based ORV bait distribution program in the western U.S.

A history of rabies in northeast Wyoming and the availability of additional special funds enabled the Wyoming WS program to hire a permanent Wildlife Biologist to conduct enhanced rabies surveillance and coordinate statewide rabies surveillance activities within WS. This position was filled in August 2007 in Campbell County and is funded solely with cooperative dollars from Campbell County, the City of Gillette, and the Campbell County Predator Management District. In addition to rabies surveillance, the Wildlife Biologist has been involved in rabies public education, prevention, and wildlife damage management activities in Campbell County.

RABIES MANAGEMENT PROGRAM 2007

Bait Distribution

There is currently no ORV bait distribution program in Wyoming.

Enhanced Surveillance

In 2007, WS assisted the ADMB with statewide rabies surveillance for the fourth consecutive year. Specimens were submitted by WS and other entities (city and town governments, veterinary clinics, animal shelters, animal control officers, and public health departments). Wildlife Services personnel frequently live trap skunks in the course of performing their normal wildlife damage management duties and use the samples for rabies testing. Wildlife Services submitted specimens from 14 counties: Albany, Big Horn, Campbell, Carbon, Converse, Crook, Goshen, Lincoln, Natrona, Niobrara, Park, Vinta, Washakie, and Weston (Figure 1). Of 310 samples (heads or carcasses) submitted to the WSVL (201 by WS and 109 by other entities/individuals), 307 were suitable for rabies testing. These included 216 skunks (not identified to species), 53 bats (not identified to species), 16 raccoons (*Procyon lotor*), 8 squirrels (not identified to species), 5 mountain lions (*Felis concolor*), 2 foxes (not identified to species), 2 bobcats (*Lynx rufus*), 1 badger (*Taxidea taxus*), 1 bear (not identified to species), 1 feral cat (*Felis catus*), 1 jackrabbit (not identified to species), and 1 mouse (not identified to species).

Campbell County Rabies Surveillance.--The Wildlife Biologist hired in August 2007 to conduct enhanced rabies surveillance targeting skunks, submitted a total of 45 animals to the WSVL for rabies testing from Campbell County, 42 (38 skunks and 2 bats) were suitable for testing. Two of 38 skunks (5.3%), and 1 of 4 bats (25.0%) tested positive for rabies. One feral cat, 1 squirrel, and 1 jackrabbit were also submitted but were not suitable for rabies testing. The numbers reported here are included in the statewide totals listed in the preceding paragraph.

Direct Rapid Immunohistochemistry Test (dRIT).--The dRIT is an unlicensed procedure designed for consideration as a potential confirmatory measure of the dFA test (the test most frequently used to diagnose rabies). In addition, the dRIT may be used to enhance field surveillance among suspect wildlife, particularly in support of ORV programs. The dRIT may be used in remote locations to improve sample turnaround and not overburden rabies laboratories, but it is not to be used for public health surveillance. Animals involved in potential or actual rabies exposures with humans or domestic animals will continue to be processed by public health experts at established local, state, or federal laboratories.

Wyoming WS has not implemented the dRIT because the WSVL is readily meeting enhanced surveillance testing needs.

Rabies Laboratory Cooperation

The WSVL in Laramie, Wyoming conducts all rabies testing on animals collected in the state. In addition to enhanced surveillance testing, the lab tests brain stems from mammals for rabies via routine public health surveillance (specimens involved in a potential or confirmed exposure). In 2007, the WSVL tested 765 animals for rabies and confirmed 19 (2.5%) rabid animals including 14 bats and 4 skunks. One horse (*Equus caballus*) tested positive for rabies in Johnson County. The positive bats originated from the following counties: Albany (1), Fremont (3), Natrona (3), Park (1) Sheridan (1), Goshen (1), Johnson (1), Big Horn (1), Campbell (1), and Converse (1). All 4 positive skunks were from Campbell County. Statewide prevalence of rabies in skunks increased from 3 cases in 2006 (n=101 samples tested).

A continuing challenge faced by the WSVL is acquiring an adequate and representative number of surveillance samples from each Wyoming County. In 2008, the WSVL expects continued funding from the ADMB

to maintain the statewide surveillance program. For more information on rabies in Wyoming, please visit: http://www.wyorabies.org/index.htm

SUMMARY

In 2007, WS focused on a general statewide surveillance program targeting skunks, with increased emphasis in the northeast portion of the state. In 2008, WS will continue to cooperate with the ADMB and the WSVL to enhance rabies surveillance and public education in Wyoming.

NATIONAL WILDLIFE RESEARCH CENTER
CONTROLLING WILDLIFE VECTORS OF RABIES 2007

BACKGROUND

The National Wildlife Research Center (NWRC), located in Fort Collins, Colorado, is the research arm of Wildlife Services (WS). To assist WS' operational National Rabies Management Program (NRMP), oral rabies vaccination (ORV) program, the NWRC, Wildlife Disease Research Program (WDRP), was requested to conduct a second five-year research project from FY 2006-2010. The objectives of this project are to: 1) determine the significance of demography, behavior, movements, and dispersal of raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) as they may relate to the transmission and rabies virus trafficking across ecosystems; 2) develop and/or evaluate methods and technologies for use by the ORV program to increase effectiveness in vaccinating free-ranging wildlife against rabies which may reduce or eliminate the transmission of rabies from wildlife to humans, livestock, and other wildlife; 3) obtain information on the ecology of gray foxes (*Urocyon cinereoargenteus)* for possible development of improved baiting strategies for the ORV program in Texas; and 4) evaluate long-term efficacy of Raboral V-RG® (V-RG) (Merial Limited, Athens, Georgia, USA) vaccine and factors that may interfere with or reduce rabies vaccination rates in free-ranging raccoons. Several studies are designed to obtain basic information on rabies in wildlife reservoirs and vectors. Pen and laboratory studies were conducted at the NWRC and Colorado State University, while field studies were conducted in Alabama, Ohio, Pennsylvania, and Texas, all states with current ORV programs (Figure 1). Studies include research on: bait development to better deliver V-RG to raccoons and skunks; ecology of raccoons and gray foxes in rural and urban areas; better use of biomarkers to evaluate vaccine uptake by target and non-target wildlife; the evaluation of geographic barriers for wildlife dispersal that may affect the spread of rabies; and determining long-term efficacy of V-RG vaccine in raccoons.

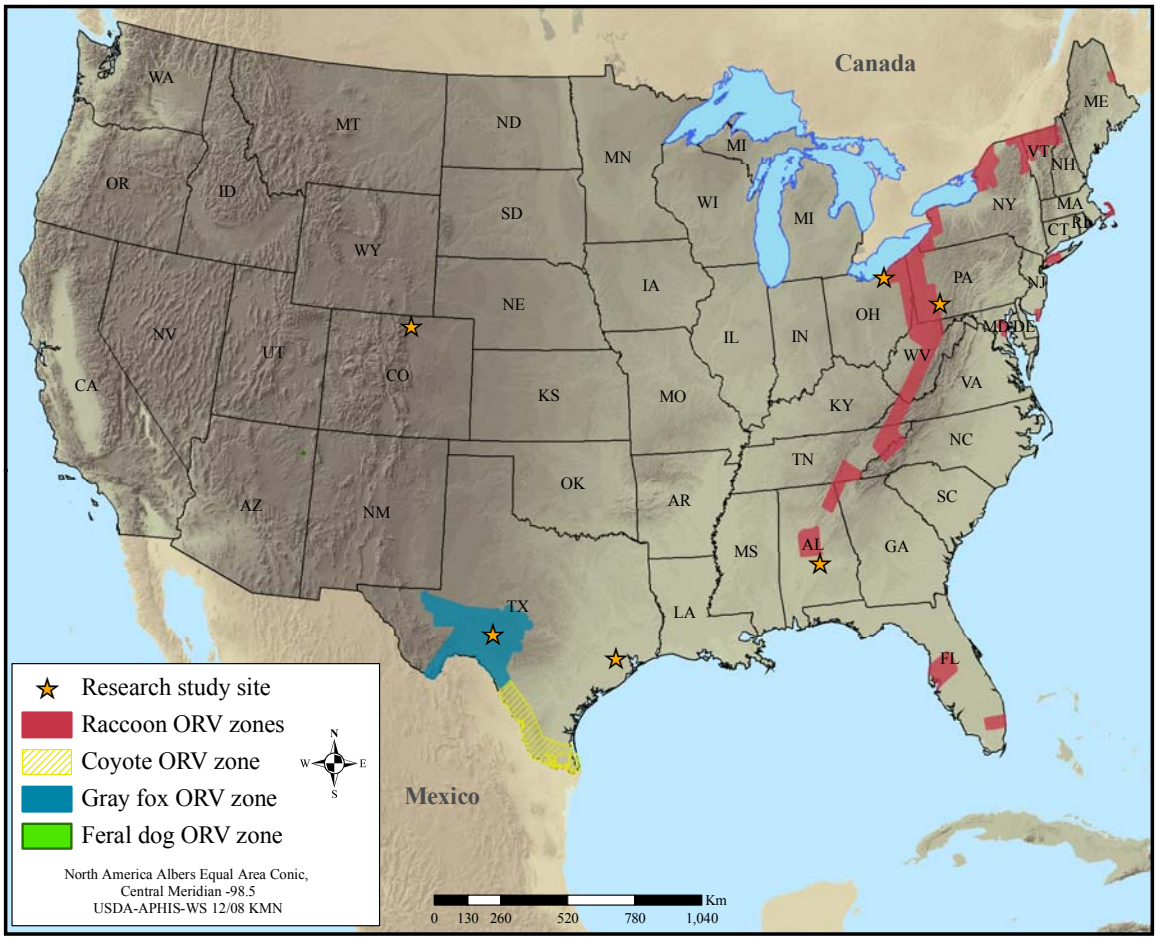

Figure 1. Wildlife Services' (WS) National Wildlife Research Center cooperative rabies research sites and WS' operational oral rabies vaccination (ORV) zones in the United States, 2007.

RESEARCH PROGRAM 2007

NWRC, WDRP Research Studies

"Ecology of the gray fox in relation to oral rabies vaccination programs in Texas" (QA 1223).--This study began in January 2005 and was completed in 2007. The objectives are to: 1) evaluate movements, dispersal, and home range of gray foxes in and near the present ORV zone in west-central Texas; 2) analyze gene flow in the fox population; 3) evaluate survival and population densities; and 4) use GIS to examine habitat use and other parameters. Monitoring locations of gray foxes are continuing on 3 study sites. Presently, >40 gray foxes have been trapped and fitted with VHF/GPS radio collars and are being monitored for locations and movements. Preliminary data indicate that male foxes move greater distances compared with females. Long distance movements by males include 13 km in Kerr County within the ORV zone and 8 km in Sutton County inside the circle of the historic "donut-hole" ORV zone. More recently, additional long-distance movements of gray foxes have been noted, including 1 male that putatively moved >100 km and movements of 19 and 14 km by 2 female gray foxes. The information obtained in this study will be used in the determination of future ORV baiting strategies to prevent the spread of rabies in foxes in Texas. In addition, a population genetic analysis has been completed. These preliminarily genetic analyses also indicate long distance movements occur in gray fox populations, which has obvious implications for ORV zones. Field work was completed in late FY 07 and data analysis should be completed in FY 08. A manuscript associated with the genetics portion of this study will be submitted to the Journal of Wildlife Management in early 2008.

"Use of genetic analyses to determine the effects of the Alabama River in Central Alabama as a natural barrier on preventing the western spread of rabies" (QA 1105).-- In late FY 06, the rabies project completed funding and support of a graduate student in an MS program at Auburn University who was conducting a radio-telemetry study on raccoon movements and dispersal in relation to the Alabama River in collaboration with WS staff in Alabama and an Olympia, Washington field station NWRC scientist. This research determined that a few (3 of 70) of the raccoons in the study did cross the Alabama River and that the river did not constitute a complete barrier (see section under "Collaborative University-Based Research"). Scientists at the NWRC in Ft. Collins added a genetic analysis of raccoon movement by obtaining individual genotypes using tissue samples collected from raccoons from the same 3 study sites as was used by the graduate student. Preliminary results are similar to the radio-telemetry results. Some of the sites on opposite sides of the river are not genetically differentiated indicating that the Alabama River in central Alabama does not constitute a complete barrier to raccoon movement and dispersal. Furthermore, a study site further northwest of the river appears genetically differentiated from the central Alabama sites located on either side of the river. Additional analysis is currently underway and should be completed in 2008.

"Movements of raccoons associated with ridges and valleys in Pennsylvania" (QA 1359).--This study was initiated in late 2006. One term biological science technician was hired to conduct the majority of the field work for this study and was stationed in Bolivar, Pennsylvania. This position was terminated in late 2007. The field portion of the study was completed. Data analysis suggests that most raccoons in the study were fairly sedentary. No valley-to-valley movements have been observed, but 1 ridge-to-valley movement covering about 6 miles in straight-line distance was observed. A second set of transmitters was deployed during the spring of 2007 with a focus on sub-adult males. In addition, a landscape genetics approach is being used to assess allelic differences among multiple populations of raccoons at 5 to 10 study sites associated with ridges and valleys. Additional genetic samples were collected during the spring and summer of 2007. All genetic assays are complete and a manuscript will be submitted to Vector-Borne and Zoonotic Diseases in 2008.

"Evaluation of raccoon movements, dispersal, habitat, and population genetics to predict the probability of the westward spread of rabies in northern Ohio" (QA 1375).--This study was initiated in September 2006. One term biological science technician was hired to conduct the study and is stationed in Cleveland, Ohio. During 2007, 50 collars were deployed, including re-deployment of collars either dropped or recovered from mortalities. Ten mortalities were reported from unknown causes and scientists have experienced numerous collar failures. The cause of these failures is under investigation by the manufacturer. Currently, 14 animals are being tracked via radio telemetry at least once weekly. Locations of raccoons and genetic sampling sites along with locations of parks, highways and waterways are being plotted using GIS software. Genetic samples from 100 raccoons were collected, with an ultimate goal of 180. Genetic analysis of samples will be conducted in collaboration with Kansas State University. The study is on schedule and should be completed in FY 09.

"Vitrification of Raboral V-RG for Improved Vaccine Stability" (QA 1334).--A Cooperative Research and Development Agreement (CRADA) was signed and approved by NWRC and Merial Limited pharmaceutical company who has license for the V-RG rabies vaccine, which is being used in this study, and who manufactures the vaccine. This vitrification process, if proven successful, should further stabilize the current V-RG vaccine used in the ORV program which should increase vaccination rates in raccoons and other free-ranging wildlife, including gray foxes. The excellent collaboration between the Invasive Species Technology Development (ISTD) and the WDRP at the NWRC will allow this new and exciting process of thermal stabilization of vaccines to not only produce more stabile vaccines but allow the development of more efficient oral bait delivery systems due to the dry formulation of the rabies and other vaccines. The initial work on the process during 2007 has established a set of possible components for use in the vitrification process that do not inactivate the vaccinia virus used in the V-RG vaccine. The first set of experiments has also established the ability to run the vitrification procedure and have live vaccinia virus at the end of the production. Further studies will establish preferred parameters for conditions and chemical components for use in the process. Testing will also verify the effects of vitrification on improving vaccine stability and the physical characteristics of the resulting material that will affect how it might be used.

"The utility of Rhodamine B as a biomarker in raccoons." (QA 1410).--This study explored the use of rhodamine B as a potential biomarker in raccoons with the intent of incorporating it into the ORV program. Rhodamine B, a dye, stains the oral cavity of animals consuming it and is absorbed systemically in growing tissues, such as hair and vibrissae, resulting in fluorescent orange bands that can easily be observed under ultraviolet (UV) light. Eighteen penned raccoons were fed a solution containing 100 mg (n = 6), 150 mg (n = 6), or 200 mg (n = 6) of rhodamine B; two raccoons were used as controls. Scientists monitored whiskers and hair for fluorescence using a hand held UV magnifying lamp and a UV microscope for 13-weeks post-treatment. All raccoons given rhodamine B exhibited fluorescence in their whiskers during the study. Fifty-two percent of whiskers sampled from each treated individual exhibited fluorescence. At the conclusion of the study, scientists conducted necropsies on all raccoons to evaluate possible pathologic effects of rhodamine B. Results of the necropsies suggested that rhodamine B did not have any pathologic effects. The benefits of rhodamine B over tetracycline, the biomarker currently used by the ORV program, include: being less invasive, marks all age classes, provides a more timely evaluation of biomarker uptake, and it drastically reduces the costs associated with biomarker evaluation. Scientists completed this study in 2007 and its success has resulted in the initiation of 3 additional studies including the one reported below.

"Evaluation of acceptance by raccoons to food containing rhodamine B." (QA 1483).--The goal of this study was to confirm that raccoons did not exhibit a taste aversion to rhodamine B when it comprised approximately 1% of a food source. Eight raccoons were fed food laced with rhodamine B on 5 occasions. Time to consumption was consistent with unlaced food; hence, scientists are able to draw the conclusions that raccoons are not averse to eating foodstuff containing rhodamine B. Information obtained from the 2 studies on rhodamine B (QA 1410 and QA 1483) are leading to additional research including a field test of rhodamine B to assess its ease of evaluation of the biomarker by field biologists and technicians, as well as pen studies to find a minimal marking dose of rhodamine B. This study was completed in 2007. Scientists will begin these additional studies in 2008.

"*An evaluation of scented oils and lures to attract raccoons*." *(QA 1497).*--Determining which scents are more attractive to raccoons will likely increase the encounter rate of raccoons with baits; thereby, increasing the vaccination rate of raccoons targeted by the ORV program. This study, which began in fall of 2007, is using captive raccoons to evaluate the effectiveness of 2 commercially available lures and 7 extracts/oils. Using classical and operant conditioning techniques, raccoons are being conditioned to move and acclimate to new pens where attractants are placed. Raccoons are then exposed to 4 attractants over a 24-hour period, the number of visits to each attractant is recorded using Reconyx™ (Holmen, Wisconsin, USA) trail cameras. From this pen study, scientists plan to glean information that will allow them to conduct a field study on a more limited number of preferred attractants. This study is expected to be completed by the end of 2008.

"Effects of naturally occurring orthopoxviruses on successful Raboral V-RG® vaccination in raccoons" (QA 1354).--This study attempted to determine if raccoons experimentally vaccinated with a recombinant raccoonpox virus vaccine developed a lower antibody response to Raboral V-RG® (a vaccinia virus vectored vaccine). The rationale behind this project was that it was unknown if naturally occurring orthopoxvirus antibodies (e.g., raccoonpox virus) inhibited rabies virus antibody titers derived from V-RG. The study is complete and a manuscript has been submitted to BMC Immunology.

"Exploratory Development of an Orthopoxvirus (Vaccinia) Detection Assay" (QA 1458).--This study is intended to provide tools for serologic assays to detect exposure to orthopoxviruses and hopefully to differentiate between vaccinia exposure for the V-RG vaccine and other orthopoxviruses in the environment. This would complement QA 1354 as well as allow for evaluation of vaccination and other testing. This protocol is being conducted under a CRADA with Merial Limited. The testing needs to be valid for a variety of species, so a novel approach is needed and so two possible methods are being developed. Progress on both methods is currently at the stage of developing reagents.

"Investigation of serologic crossreactivity to rabies virus in wild raccoons" (QA 1377).--This study is a spin-off from the study conducted on Plum Brook Station, Ohio, where it was inadvertently found that raccoons had a high prevalence of rabies titers (48%) in the spring, before experimental vaccination, compared with a low prevalence (8%) after field vaccination. This study will attempt to determine to which rabies variant the rabies titer was generated and why did the titer fall in the raccoon population after vaccination. The technology that will be used initially is the Ouchterlony test (a double gel diffusion test). Later, the Western Blot test will be used. This could have far-reaching implications in the ORV program if scientists could determine that antibodies generated by contact with certain rabies variants may interfere with antibodies generated by V-RG. It should also be noted that this phenomenon has occurred in other states and areas as well as Ohio. This study will begin as soon as rabies antigens from different variants can be produced. The aim of this study is to answer two questions: 1) what is the source of antibody titers to rabies in raccoons residing in a non-raccoon rabies enzootic area? and 2) why are titers higher in the spring than in the autumn even when vaccination takes place in the summer? To address these questions, two hypotheses have been formulated for testing: 1) rabies antibodies in raccoons in non-enzootic areas can occur due to crossreactivity with skunk variants of rabies that are not lethal to the raccoons, but which can infect and induce an immune response in the animals; and 2) female raccoons that have been previously exposed and developed rabies virus neutralizing antibodies (VNA) have a resurgence of antibody production during pregnancy in order to protect their offspring by passive transfer. This may account for an increase in titer prevalence and frequency in the spring. This study will continue into 2008.

"Evaluation of the significance of neutralizing antibodies to rabies virus in non-vaccinated raccoons" (QA 1501).--This study is designed to look at low titer rabies neutralizing antibodies in raccoons outside of the raccoon variant enzootic area. The study is based on the fact that was determined nearly 25 years ago that the northern skunk variant is not lethal to raccoons. If this is true, would this variant cause protective VNA to occur in raccoons and would raccoons carry such a non-lethal variant? Fifty-six raccoons were trapped in Texas by Texas WS personnel in collaboration with NWRC scientists. Blood samples were collected and sent to CDC for evaluation of VNA against rabies. The area selected in Texas was where raccoon rabies has not been detected, but where skunk rabies is enzootic and the area has been experiencing an epizootic for the past few years. Only 3 of the 56 (5%) raccoons demonstrated a positive rabies VNA response. This information led NWRC scientists to cancel a penned study in collaboration with CDC that would have challenged the positive raccoons with the raccoon variant. However, in another portion of the same study, samples of tonsil, salivary glands, brain, and blood will be obtained from raccoons from Kansas to evaluate a carrier status of the non-lethal northern skunk rabies variant in raccoons, again where the raccoon rabies variant is non-enzootic. Tissues will be tested for rabies virus by PCR and growth in tissue culture. Trapping of these raccoons has not yet begun, but is expected to occur in 2008. Additional captive studies are expected to be conducted in collaboration with KSU to further study this interesting question.

NWRC, WDRP Collaborative University-Based Research

Pennsylvania State University.--In 2006, the NWRC completed funding of a PhD graduate student at Pennsylvania State University who was studying the zoogeography of raccoons in Pennsylvania by evaluating the home range, den-site fidelity, movement patterns, and dispersal rates of raccoons in forested and mixed-agriculture habitats. This study found that raccoon movement patterns shift depending on food supply and onset of furbearer trapping season. Also, the student determined that landscape in the study area does not inhibit a raccoon's movement. This information may be applied to management recommendations that will soon be made to the NRMP concerning baiting and vaccinating raccoons for rabies in rural environments. This study was completed in late 2006. A completed report was made available to NWRC and was forwarded to stakeholders in early 2007.

Auburn University.--The NWRC completed funding of a MS student at Auburn University who studied raccoon movements and dispersal in relation to the Alabama River, as well as evaluated raccoon home range, habitat

use, and survivorship of raccoons. Seventy of 127 raccoons captured were radio collared for telemetry. Only 3 of the 70 collared raccoons crossed the Alabama River, all of which were males, suggesting that the Alabama River does not constitute a complete barrier to raccoon movement and thus dispersal of rabies virus across this ecosystem. Data indicate that males appear to have larger home ranges compared with females in the same habitat type. Home range sizes ranged from a mean for females of 79.6 hectares in riverine habitat types to 396.8 hectares for males in managed forests. Survival, both annual and during the fall, did not differ between habitats for males or females. Mortality was low and hunting may have been the main cause of mortality. Data analysis is complete and a manuscript is anticipated early in 2008.

SUMMARY

Scientists at the NWRC have determined that: movement of gray foxes in Texas was much greater than anticipated and foxes move outside the present ORV zone; raccoons inhabiting the ridge-and-valley system in Pennsylvania do not move between valleys; and the Alabama River in Central Alabama does not constitute a natural barrier to raccoon movement and dispersal in a westward direction. Results of these studies should assist in guiding baiting/vaccination strategies in the ORV program that may reduce costs and increase program efficiency. Several studies were initiated in 2007 which, when completed, should have direct benefits to the ORV program. These in-progress studies will attempt to: determine quantitatively the effect of the Alabama River as a barrier to raccoon movement and dispersal by use of sophisticated genetic analyses; determine if and how raccoon movements in Cleveland, Ohio could traffic rabies through the urban and adjacent rural areas of Ohio; develop a more stabilized V-RG vaccine by use of the vitrification process; use Rhodamine B as an alternative to tetracycline as a biomarker for use in the ORV program; develop methods and reagents for testing for orthopoxvirus exposure (vaccine or natural); determine if raccoons are attracted to ORV baits by use of various scents and oils; and determine why rabies antibody titers in Ohio raccoons change seasonally and possibly interfere with vaccination with V-RG. These accomplishments by NWRC research scientists over the past year, which were funded by the WS operational NRMP, have assisted the ORV program in being more efficient in vaccinating free-ranging raccoons against rabies at reduced costs to the program. The NWRC will continue to conduct research and collaborate with others to assist the NRMP in carrying out its mission of containing and eventually eliminating terrestrial rabies from the United States.